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GENERAL DESCRIPTION

The cooling system on all 1969 Cadillac engines has been designed to be kept sealed at all times. This has been made possible by adding a coolant reservoir that keeps the system full, indicates the need for additional coolant, and allows coolant to be added without removing the radiator cap.

An engine coolant reservoir, Fig. 6-1, has been incorporated into the 1969 Cadillac cooling system.

A vented radiator cap is also used which allows the coolant to expand through the normally open vent valve in the center of the cap without building unnecessary pressure. The expanding coolant flows into the coolant reservoir. The vent valve closes when the temperature of the coolant nears the boiling point and pressure is needed to control boiling. The nominal 15 pound pressure will not be reached until the system is working at maximum capacity.

Any air or vapor in the cooling system will be forced to the coolant reservoir under the liquid level and leave through the vent tube at the top of the reservoir. As the system cools, the extra coolant in the reservoir will be drawn through the vent valve back to the radiator. In this manner, the radiator will keep itself full at all times. The need for additional coolant can be detected by observing the level of coolant in the reservoir while the engine is at normal operating temperature.

A seven-bladed fan and thermostatically-controlled clutch assembly are used on all air conditioned cars. The maximum speed of the fan is reduced as engine cooling needs become less.

The fan clutch is serviced only as an assembly.

A seven-bladed fan and hub-spacer is used on all non-air conditioned cars.

A cast iron water pump is mounted at the front of the engine. It is driven by a "V" belt which also drives the A.I.R. pump. The water pump is serviced only as an assembly.

Coolant is pumped to each bank of cylinders simultaneously, then through passages to the cylinder heads, through the thermostat housing at the top of the cylinder block to the left hand radiator tank. Radiator coolant flow is from the left hand tank through the core to the right hand tank, which, is the source of coolant to the water pump inlet, Fig. 6-1.

When the thermostat is closed, coolant from the cylinder heads is pumped through a by-pass passage below the thermostat housing back to the water pump and recirculated. When the engine is sufficiently warm, the thermostat opens and coolant flows to the inlet tank on the left side of the radiator, and is cooled as it flows across the horizontal core tubes to the outlet tank on the right side of the radiator, completing the cycle.

A thermo-vacuum switch is used on all 1969 Cadillac cars equipped with air conditioning. The valve is located in the front of the cylinder block just under the left cylinder head. It has four fittings, two to manifold vacuum, one to carburetor vacuum above the throttle valves and one to

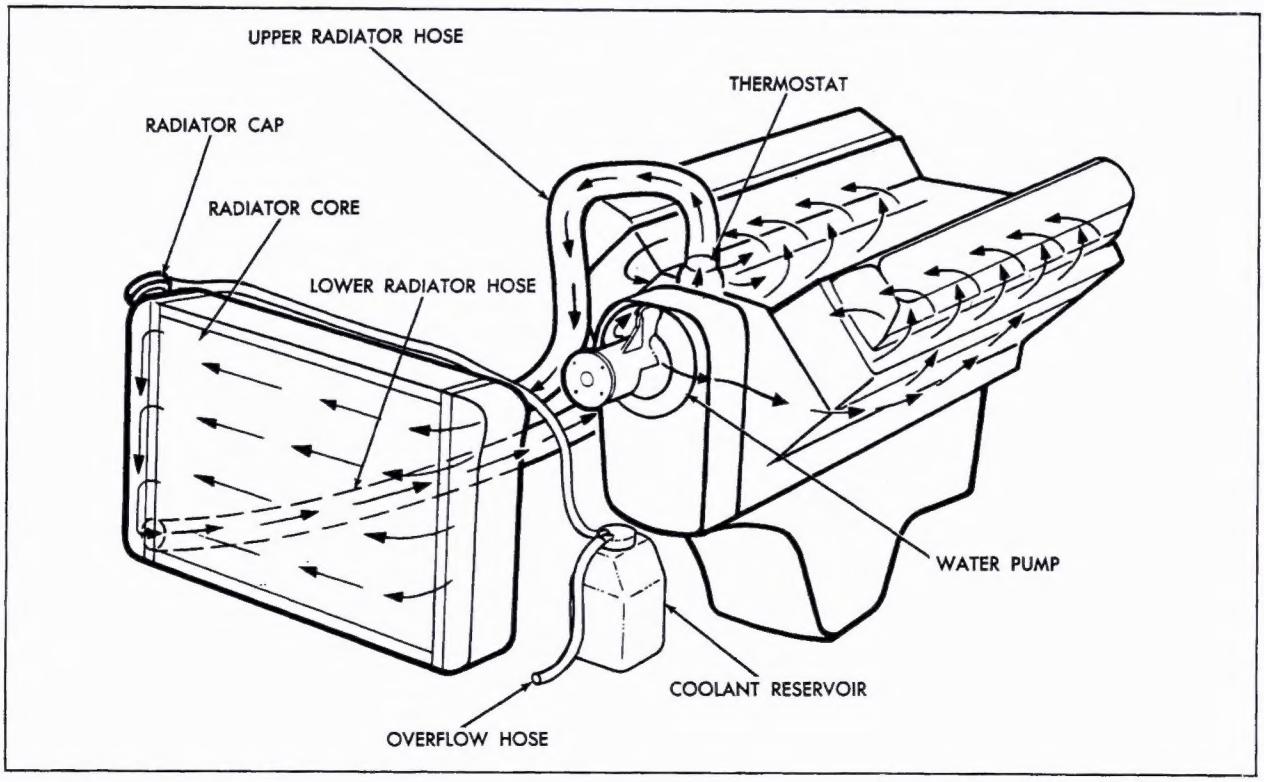


Fig. 6-1 Flow of Coolant

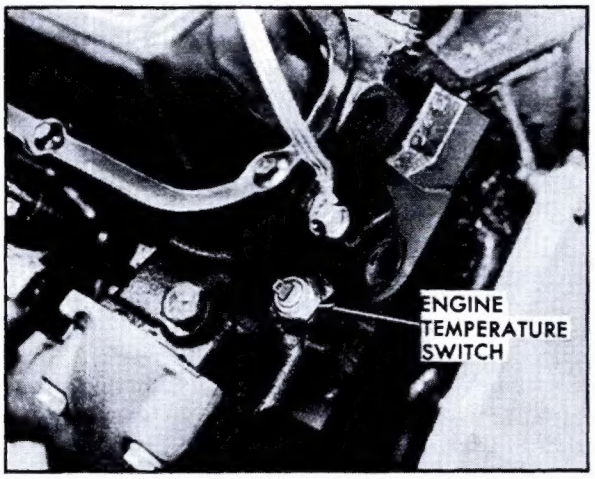


Fig. 6-2 Engine Metal Temperature Switch

the distributor vacuum diaphragm. At coolant temperatures above 220°F, this valve switches from carburetor vacuum to manifold vacuum, advancing the ignition timing to full vacuum advance at idle. This reduces the possibility of engine overheating under extremely high temperature operation. The second manifold vacuum fitting is connected to an idle speed-up device on the carburetor through the neutral switch. This device will raise the engine idle speed whenever coolant temperature is excessive and the transmission is in neutral or park. This system functions at idle when manifold vacuum is high.

The transmission oil cooler is located in the outlet tank on the right side of the radiator.

The water temperature tell-tale light, the second light to the right of the shift quadrant, is a red light reading "WATER TEMP". It will glow whenever coolant temperature becomes excessive. The light is activated by a temperature sensitive switch in the water passage directly below the air conditioning compressor. To check the operation of the "WATER TEMP" tell-tale light, turn the ignition switch to the "ON" position. With the engine not running, the light should glow. As soon as the engine is started, the light should go out.

In addition to the engine coolant temperature warning light, an engine metal temperature warning light and buzzer system is used on all 1969 Cadillacs.

The tell-tale light directly below the right turn signal indicator on the right side of the instrument cluster (Fig. 12-40) is a red light that reads "ENGINE TEMP". It will light whenever engine temperature is excessive. In addition to the glowing lamp, a buzzer will sound.

The engine metal temperature switch (Fig. 6-2), located at the rear of the left cylinder head, (front of right cylinder head on Eldorado) senses the temperature of the casting rather than the temperature of the coolant. The switch screws into a blind hole in the cylinder head, so sealer must not be used when installing this switch.

The high engine temperature warning system does not utilize the ignition switch ground circuit as do the other tell-tale lights. Therefore, the red "ENGINE TEMP" light should not glow when the ignition switch is in the "ON" position.

SERVICE INFORMATION

1. Cooling System Preventive Maintenance

Regardless of climate, the cooling system should be drained, flushed with water only, and refilled every 24 months with water and an ethylene glycol base coolant to protect the engine to at least -20°F. Check all hose connections and add cooling system conditioner whenever ethylene glycol base coolant is changed. These measures are necessary to retard corrosion, rust and scale, keep water passages open, seal against internal or external leakage and give the earliest possible indication of trouble.

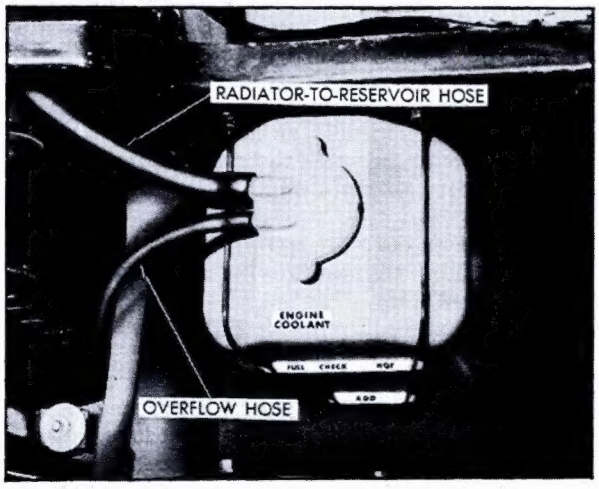


Fig. 6-3 Coolant Reservoir

Check coolant level in reservoir at each engine oil change. The coolant reservoir is marked "FULL" and "ADD", Fig. 6-3. These marks are approximately two quarts apart so that one quart of ethylene glycol and one quart of water can be added. The reserve above the full mark is to allow for expansion while parked after hot running. The coolant level should be between the "FULL" and "ADD" marks at normal operating temperature. The level may be observed below the "ADD" mark when the system cools below operating temperature.

2. Radiator Filler Cap Removal

The radiator cap, Fig. 6-4, should only be removed during engine draining, addition of coolant

because the coolant level has dropped below the "ADD" mark in the reservoir, or when coolant has not been moving in and out of the reservoir.

3. Testing Coolant Solutions

A hydrometer test will indicate whether ethylene glycol or water, or both, should be added to maintain the desired freezing point of the solution. The freezing point of the solution should give protection to at least -20°F, regardless of climatic conditions. This is necessary to provide adequate corrosion protection.

Some devices used for testing solutions will indicate the correct freezing point only when tested at a specific temperature. Other testers, provided with thermometers and tables, indicate freezing points corresponding to readings made at various temperatures. Disregarding the temperature of the solution when testing may cause an error as large as 30°F in determining the freezing point.

4. Radiator and Cap Leak Check

The cooling system pressure should be checked whenever cases of overheating, coolant loss, or coolant odors are reported. Any one of the common types of cooling system testers will prove helpful in testing the cooling system according to the following procedure:

a. Testing Radiator Cap

CAUTION: The radiator cap should not be removed while the engine is at normal operating temperature. If it is necessary to remove the cap while the engine is hot, first relieve the pressure in the system by opening the radiator drain cock. Then remove the radiator cap.

1. Remove radiator cap.
2. Wet cap gasket with water and wash away sediment, if any, then install cap on tester.

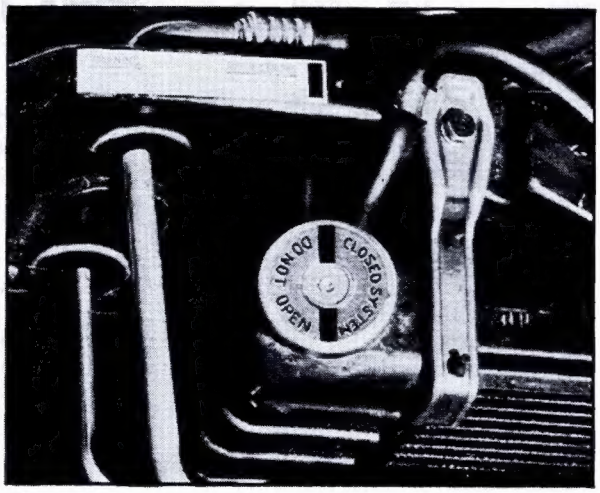


Fig. 6-4 Radiator Cap Warning

3. Build up pressure to cap capacity. The tester should read between 13-1/2 and 16-1/2 psi.
4. The cap should hold the pressure within these limits for approximately 10 seconds. A cap that does not meet these requirements should be replaced.

b. Testing Cooling System

1. Tighten all hose connections.
2. Fill radiator completely to cap seat.
3. Install tester in radiator neck following instructions supplied with tester.
4. Build pressure up to 20 psi.
5. The cooling system should hold this pressure for approximately two (2) minutes. An earlier pressure drop will indicate a leak.

5. Thermostat Test

The thermostat may be checked by suspending it, with the thermostat heat control unit down, in a small pan of ethylene glycol coolant containing a thermometer. Neither the thermostat nor the thermometer should rest on the bottom of the pan because of the uneven concentration of heat at this point when the pan is heated. The thermostat valve should start to open at a temperature between 192°F. and 197°F. When the coolant reaches a temperature of 217°F. the valve should be fully open (approximately 7/16 inch).

6. Cooling System Flushing Procedure

1. Drain coolant from cooling system by opening radiator drain cock and removing two drain plugs from cylinder block. If coolant side of radiator cap is rusty, flush system twice.
2. After the drain points have been closed, refill system with fresh water only and install radiator cap. Set defroster lever to ICE position and turn temperature to 85°. This opens the water control valve and allows the water to pass through the heater core.

NOTE: On Fleetwood Seventy-Five sedans and limousines, also turn rear heater system on and rotate temperature dial to 85°.

3. Run engine at medium speed for one-half hour at a temperature as hot as possible without boiling. Cover one-half the radiator if necessary.
4. Inspect the following points in the cooling system:
   a. Radiator core for leaks.
   b. Radiator air passages for plugging caused by bugs, leaves, etc.
   c. Condition and tension of drive belts, as described in Note 11.
   d. Condition of hoses and tightness of clamps.
5. Drain system by opening all drains. If flush water has a rust color, repeat procedure.
6. After the drain points have been closed, add the required amount of ethylene glycol base coolant with water to protect engine to as least -20°F.

Also use cooling system conditioner regardless of whether or not the coolant used contains an inhibitor.

7. With the radiator cap removed and heater controls on maximum as outlined in step 2, run engine with throttle set on fast idle cam for 10 minutes. Add coolant until the radiator is completely full and tighten radiator cap before stopping engine.

8. Check coolant level in the reservoir and add coolant as necessary to bring level up to the "FULL" mark.

7. Thermostat

a. Removal

1. Drain radiator until coolant level is below level of thermostat housing.
2. Disconnect upper radiator hose at thermostat housing.
3. Remove two screws securing thermostat housing to cylinder block and remove housing. Discard gasket.
4. Remove thermostat from cylinder block.

b. Installation

1. Install thermostat in opening at top of cylinder block with valve up.
2. Position a new gasket coated with gasket cement on cylinder block.
3. Install thermostat housing on cylinder block and secure with two screws. Tighten screws to 10 foot-pounds.
4. Connect upper radiator hose to thermostat housing.
5. Fill cooling system to proper level.

8. Fan Blade and Clutch Assembly (Air Conditioned Cars)

a. Removal

1. Remove four screws securing hub to water pump pulley. Remove fan blade and clutch assembly.
2. Remove four nuts that secure fan blade to fan clutch.

NOTE: Fan clutches used on air conditioned cars should always be kept in an "in car position." When removed for any reason, support assembly to keep clutch disc in a vertical plane to prevent leakage of silicone fluid from clutch mechanism.

b. Installation

1. Attach fan blade to clutch with four nuts.
2. Attach clutch and fan assembly to water pump pulley with four screws.

9. Fan Blade (Non-Air Conditioned Cars)

a. Removal

Remove four screws securing fan and spacer to water pump pulley and remove fan and spacer.

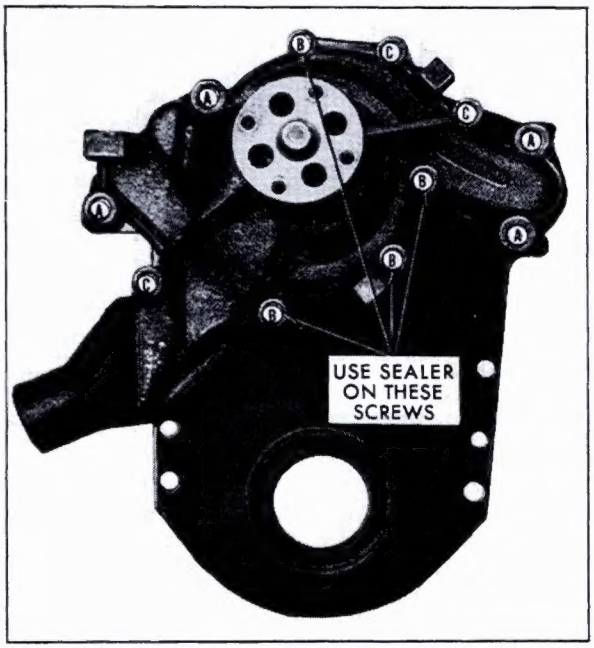
b. Installation

Insert four screws through fan and spacer and position on water pump pulley. Secure fan and spacer to water pump pulley by tightening screws.

10. Water Pump Assembly

a. Removal

1. Disconnect negative battery cable.
2. Drain radiator.
3. Remove fan assembly as described in Note 8a or 9a.
4. Loosen generator mounting screws and remove generator belt.
5. Loosen A.I.R. pump mounting screws and remove A.I.R. pump belt.
6. Loosen power steering pump mounting screws and remove power steering pump belts.
7. Pull water pump pulley off water pump shaft.
8. Disconnect water inlet from water pump.
9. Remove 11 screws securing water pump to engine front cover, Fig. 6-5, and remove pump. Discard gasket.



Key	No.	Size	Torque
A	(4)	3/8 - 16 x 1-3/8	22 foot-pounds
B	(4)	1/4 - 20 x 1-1/8	70 inch-pounds
C	(3)	5/16 - 18 x 1-1/4	15 foot-pounds

Fig. 6-5 Water Pump Assembly Attaching Screws

b. Installation

1. Position new gasket on water pump flange.
2. Position pump on engine, lining up holes in pump with holes in engine front cover, and install eleven screws with sealer as indicated in Fig. 6-5.
3. Connect water inlet hose to pump.
4. Position water pump pulley on pump.
5. Loosely install all drive belts.
6. Install fan assembly as described in Note 8b or 9b.
7. Tension all drive belts as described in Note 11.
8. Fill cooling system to proper level with ethylene glycol base coolant as described in Note 1.
9. Reconnect negative battery cable.
10. Run engine and check for leaks.

11. Belt Adjustments

a. Checking Drive Belts

1. Drive belts should be checked for signs of

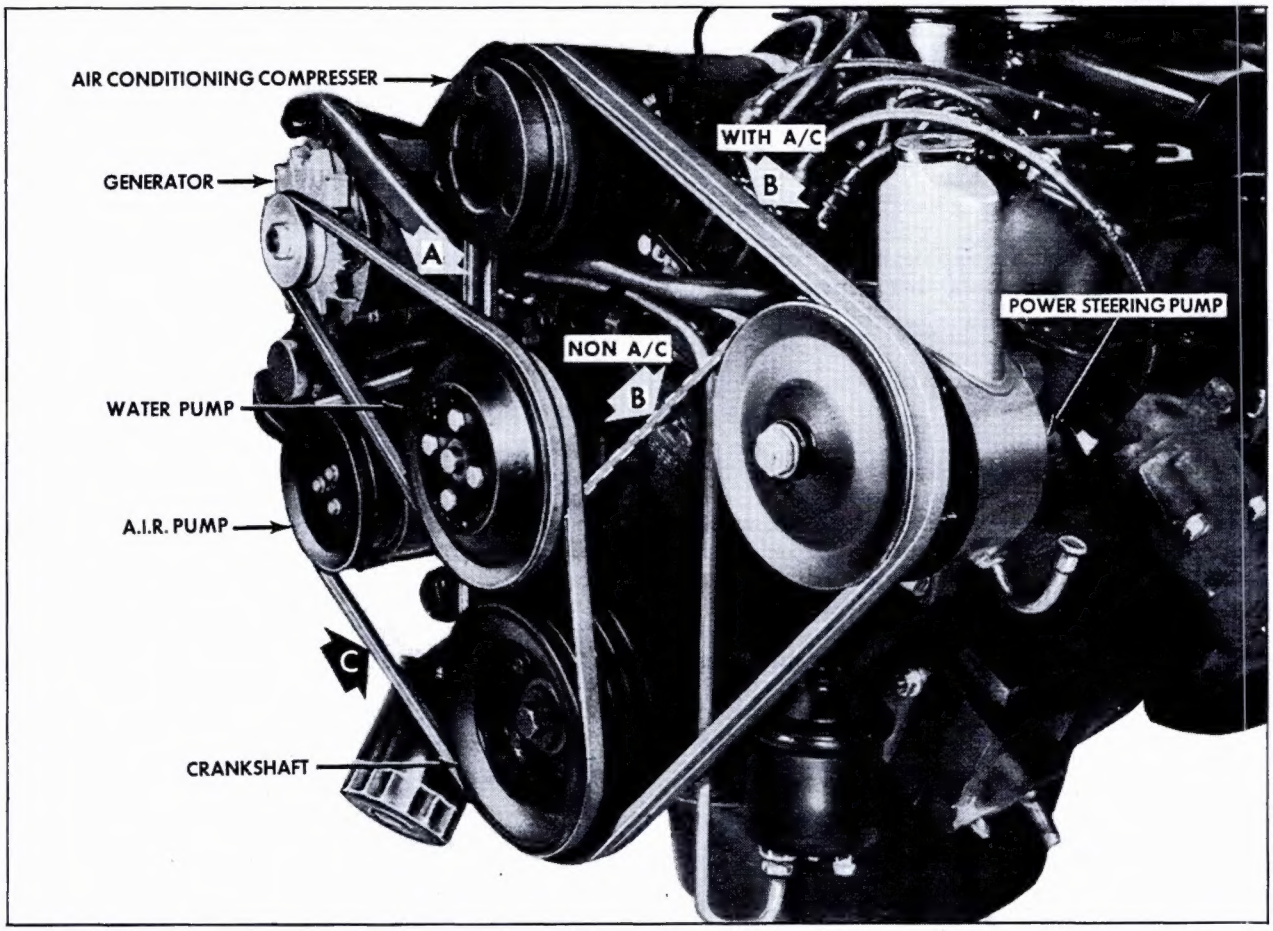


Fig. 6-6 Belt Tensioning

Belts	Number of Belts Used	Type	Tension		Width	Length
			New	Used		
Generator	1	38° Wedge	100 Lbs.	55-70 Lbs.	.470"	35.50"
Power Steering Pump (Non-Air Conditioned Cars)	1	38° Wedge	100 Lbs.	55-70 Lbs.	.380"	48.00"
Power Steering Pump and Air Conditioning Compressor	2	38° Wedge	100 Lbs.	55-70 Lbs.	.380"	59.00"
A.I.R. System Air Pump	1	38° Wedge	100 Lbs.	55-70 Lbs.	.470"	45.50"

unusual wear, cuts and fraying. Worn belts should be replaced.

2. On dual belt arrangements, such as the power steering pump belts, if it is necessary to replace one belt, replace both belts to equalize tension on both belts.

3. Place Belt Tension Gage, J-7316 midway between pulleys on drive belt being checked, locations A, B or C, indicated in Fig. 6-6.

4. Check gage reading for belt being checked. Proper belt tension is 55 to 70 foot-pounds for a used belt, and 100 foot-pounds for a new belt. If belt tension is incorrect, adjust specific belt according to the corresponding procedure described in b, c, or d of this Note.

5. A belt that has been previously tensioned is considered a used belt and should be tensioned to the 55 to 70 foot-pound specification. A belt that has never been tensioned is considered a new belt and should be tensioned to 100 foot-pounds.

6. If after tensioning, a belt fails to maintain 55 foot-pounds tension, it should be replaced.

b. Generator Belt Tension

1. Place Belt Tension Gage, J-7316 on drive belt midway between pulleys at location A in Fig. 6-6.

2. Loosen generator link adjusting screw and pivot screw under generator.

3. Move generator as required until correct belt tension is obtained on gage.

4. Tighten generator link adjusting screw to 10 foot-pounds.

5. Tighten pivot screw under generator to 10 foot-pounds and remove Belt Tension Gage.

c. Power Steering Pump and Air Conditioning Compressor Belt Tension

1. Place Belt Tension Gage, J-7316 on drive belt midway between pulleys at location "B", shown in Fig. 6-6.

2. Loosen, (1) steering pump adjusting nut at top of pump mounting bracket, (2) lower adjusting slot bolt and (3) pivot bolt.

3. Move power steering pump as required until correct belt tension is obtained on gage.

4. Snug lower adjusting slot bolt.

5. Snug lower pivot bolt.

6. Snug upper adjusting slot nut.

7. Tighten lower adjusting slot bolt to 20 foot-pounds.

8. Tighten lower pivot bolt to 20 foot-pounds.

9. Tighten upper adjusting slot nut to 20 foot-pounds.

d. A.I.R. Pump Belt Tension

1. Raise front of car.

2. Remove right hand acromat.

3. Loosen A.I.R. pump pivot bolt.

4. Place Belt Tension Gage, J-7316, on drive belt midway between pulleys at location C in Fig. 6-6.

5. Loosen A.I.R. Pump adjuster link screw below pump and pivot screw above pump.

6. Move A.I.R. Pump as required until correct belt tension is obtained on gage.

NOTE: Pry as close to rear of pump cover as possible, near dowel pin.

7. Tighten adjuster link screw.

8. Tighten pivot screw and remove Belt Tension Gage.

9. Replace acromat and lower car.

DIAGNOSIS CHART

CONDITION	CAUSE	REMEDY
Engine overheats.	Loss of coolant.	Determine reason for loss and correct as necessary.
	Loss of system pressure.	Check radiator cap, replace as necessary. Check hose connections and tighten as necessary.
	Belt tension too low.	Tighten belt to specification.
	Radiator fins obstructed.	Clean away bugs, leaves, etc.
	Thermostat defective.	Install new thermostat.
	Cooling system passages blocked by rust or scale.	Flush cooling system - add fresh coolant, and cooling system conditioner.
	Fan clutch not engaging properly (as in slow speed high engine temperature conditions).	Install new clutch assembly.
	Water pump inoperative.	Replace water pump.
	Spark timing incorrect.	Set timing to specification.
Engine fails to reach normal operating temperature. (Cool air from heater.)	Thermostat stuck open or of incorrect heat range.	Install new thermostat of correct type and heat range.
Loss of coolant.	Leaking radiator.	Repair radiator.
	Leaking coolant reservoir or hose.	Replace reservoir or hose.
	Loose or damaged hoses or connections.	Reseat or replace hoses or clamps.
	Water pump seal leaking.	Replace water pump.
	Water pump gasket leaking.	Replace gasket.
	Cylinder head gasket leaking.	Replace gasket.
	Improper cylinder head screw torque.	Tighten screws to 115 foot-pounds.
	Cylinder block core plugs leaking.	Replace core plug.
	Cracked cylinder head or block or warped cylinder head or block gasket surface.	Resurface or replace.
	Radiator cap or sealing surface defective.	Repair or replace.
	Leaking heater core.	Repair or replace core.
	Leaking heater water control valve.	Replace valve.

TORQUE SPECIFICATIONS

Material Number	Application	Size	Torque
280M	Fan Blade Assembly Mounting Screw on Air Conditioned Cars	5/16-24	18 Ft. Lbs.
260M	Fan Blade Assembly Mounting Screw on Non-Air Conditioned Cars	5/16-24	18 Ft. Lbs.
280M	Fan Blade to Clutch Mounting Screw Air Conditioned Cars	5/16-24	20 Ft. Lbs.
1010	Heater Hose Clamp	10-24	13 In. Lbs.
280M	Thermostat Housing Screw	5/16-18	10 Ft. Lbs.
260M	*Water Pump to Cylinder Block Screw	3/8-16	22 Ft. Lbs.
260M	*Water Pump to Cylinder Block	5/16-18	15 Ft. Lbs.
260M	*Water Pump to Front Cover Screw	1/4-20	70 In. Lbs.
	*Refer to Fig. 6-5 for proper screw location.		

NOTE: Refer to back of manual, Page 16-1 for nut and bolt markings and Steel Classifications.

SPECIFICATIONS

Fan	
Number of Blades Air Conditioned Cars	7
Non-Air Conditioned Cars	7
Hoses	
Type	Reinforced Molded
Thermostat Housing to Radiator Inlet (Top)	Diameter Inside 1.50"
Radiator to Water Pump Inlet (Bottom)	Diameter Inside 1.50"
Thermostat	
Starts to Open	192°F. to 197°F.
Fully Open (Approximately 7/16"	217°F.
Drive Belt Ratios	
A.I.R. Pump	1.20 to 1
Water Pump (with A/C)	1.24 to 1
Water Pump (without A/C)	1.14 to 1
Generator (with A/C)	2.85 to 1
Generator (without A/C)	2.74 to 1
Power Steering Pump (without A/C)	1.26 to 1
Air Conditioning Compressor	1.48 to 1
Capacity of System (with Heater)	21.3 Qts.
Capacity of System (with Air Conditioning)	21.8 Qts.
Capacity of System (Seventy-Five Series)	24.8 Qts.
Area of Core	480 Sq. In.
Core Depth	
Non-Air Conditioned Car	1.26 In.
Air Conditioned Cars	1.98 In.
Core Center Constant	
Non-Air Conditioned Cars	.20 In.
Air Conditioned Cars	.16 In.
Tubing Spacing	.55 In.
Radiator Cap Pressure	13.5 to 16.5 psi

GENERAL DESCRIPTION

Battery

The familiar 12-volt negative-ground type electrical system is used on all 1969 Cadillac vehicles. A 12-volt secondary solid top battery, Fig. 6-7, is mounted in a tray on the right side of the radiator cradle assembly. The retainer grooves in the front and rear bottom sides of the battery, Fig. 6-7 and Fig. 6-8, secure the battery to the tray by means of a locking rod. Internal structure of the battery consists of 6 cells and 90 plates. This battery has a capacity of 74 ampere hours.

The lead acid battery is a source of electrical energy that operates or assists in supplying current to the electrical accessories. Active materials within the battery react chemically to produce a flow of direct current whenever a current-consuming device, a load, is connected to the battery terminal posts.

Starter

The starter motor is mounted on the right rear side of the engine. The starter motor has four pole shoes and a two series field. The drive end housing encloses the entire shift lever mechanism. An overrunning clutch drive is used to engage the cranking motor pinion with the transmission flywheel.

When the control switch is closed, the solenoid is energized, shifting the cranking motor pinion into mesh with the flywheel. The main contacts of the solenoid are then closed so that battery current is delivered to the starter motor.

Fig. 6-7 Battery

Ignition System

An ignition distributor, of aluminum alloy, is mounted on the top left front of the engine. It is fully automatic in operation, and driven by an alloy iron gear that meshes with a gear that is integral with the camshaft. The distributor cam rotates in a clockwise direction when viewed from above. The firing order is 1-5-6-3-4-2-7-8.

The distributor houses the contact points that make and break the circuit, and also directs high voltage current in proper sequence to the spark plugs. The distributor contact point set is replaced as a complete assembly. The breaker lever spring tension and point alignment on the replacement set are factory adjusted, leaving only the dwell angle to be adjusted after installation.

The large molded distributor rotor, located above the breaker plate assembly serves as a cover for the centrifugal advance mechanism, and distributes high voltage current to fire the spark plugs.

The one-piece distributor cap is made from an alkyd substance to resist carbon tracking.

A thermostatically controlled vacuum distribution switch is mounted in the upper left front of the cylinder block.

When the coolant temperature is below 220°F, carburetor vacuum is supplied to the vacuum advance mechanism through the thermo switch. Once the coolant temperature rises above 230°F,

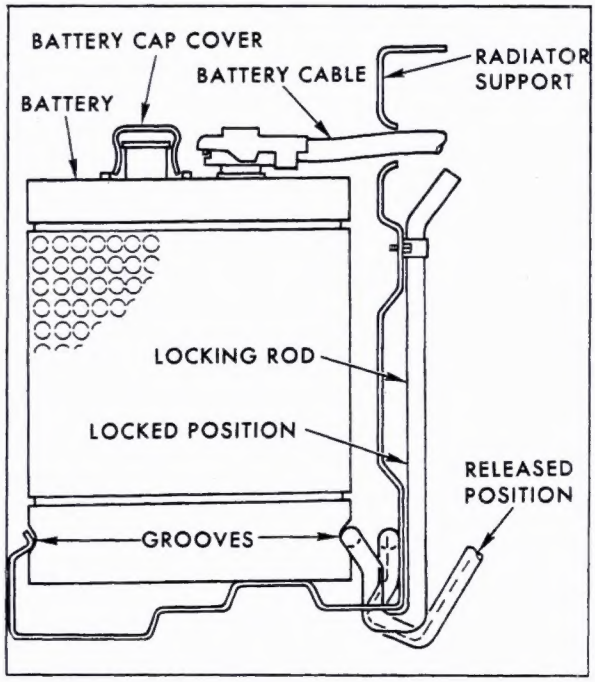


Fig. 6-8 Battery Retainer - 693

the switch closes the carburetor supply port and opens the manifold supply port.

This system is designed to provide precise spark control during prolonged idling periods or in unusually warm weather. Under these conditions, when air flow through the carburetor is nominal and carburetor vacuum is low, stronger manifold vacuum is used to operate the vacuum advance unit to provide the proper spark advance.

During normal engine operation carburetor vacuum operates the vacuum advance unit because it more closely follows actual engine requirements.

The distributor is permanently lubricated and requires no periodic oiling. However, when the rotor is removed, the centrifugal advance mechanism should be inspected for lubricant. If necessary, a small amount of cam and bearing lubricant should be applied to the advance weights.

On the left side of the engine front cover directly below the distributor is a tab with three notches to indicate 0, 5 and 10 degrees of crankshaft advance. The pistons in number one and number four cylinders are at top dead center when the "0" notch is in line with notch on the rear flange of the pulley. The 5 mark and the 10 mark indicate the number of crankshaft degrees the spark plug will fire ahead of the top dead center position to the piston.

Type R-44-N spark plugs are installed as original equipment on all 1969 Cadillac engines. A ribbed insulator is used to reduce the possibility of voltage breakdown.

Radio suppression spark plugs are used in addition to resistance core spark plug cables to reduce ignition noise radiated into the atmosphere.

The oil-impregnated ignition coil is mounted on top of the intake manifold in front of the carburetor. The interrupted low tension voltage from the battery produces a high voltage in the secondary circuit of the coil. A resistance type wire is connected from the ignition switch to the ignition coil in the primary circuit. This resistor reduces the voltage at the coil from 12 volts down to a range of 8-1/2 to 10-1/2 volts under normal operating conditions. To insure adequate ignition voltage during the engine cranking period, the resistor wire is by-passed by a feed from the starter solenoid, and full battery voltage is supplied to the ignition coil during this period.

Generator (All Except Commercial Chassis With Heavy Duty Generator)

The generator is mounted on the right front of the engine. A 42 ampere generator is used on all non-air conditioned cars, except the Fleetwood Seventy-Five sedan and limousine, and the Commercial Chassis. A 55 ampere generator is used on the Fleetwood Seventy-Five sedan and limousine, commercial chassis and all other cars equipped with air conditioning and/or seat warmers.

A 63 ampere generator is available as optional equipment on all 1969 Cadillac cars. This generator is intended for vehicles that are to be equipped with a radio-telephone or other vehicles with extra heavy electrical loads.

All generators are of basically the same construction and consist primarily of a drive end frame, a slip ring end frame, a stator assembly and a rotor assembly. The rotor assembly is supported in the drive end frame by a ball bearing and in the slip ring end frame by a roller bearing.

The stator assembly, mounted between the two end frames, consists of loops of wire wound into the slots of the laminated stator frame. The rotor assembly contains a field coil wound on an iron spool. The coil and spool are mounted between two iron segments with interlacing poles. These parts are a press fit on the shaft. Two slip rings, upon which the brushes ride, are mounted on the rotor shaft. The brushes carry current through the slip rings to the field coil.

Six diodes are located in the end frame assembly nearest the slip rings. Three of these diodes are negative and are mounted directly to the end frame. Three diodes are positive and are mounted into a strip called a "heat sink", which is insulated from the end frame. The six diodes form a rectifier network that changes the alternating current voltages developed in the stator windings to direct current voltage at the "BAT", or output, terminal of the generator.

Regulator (All Except Commercial Chassis With Heavy Duty Generator)

The voltage regulator assembly is mounted on the right fender dustshield in a waterproof case.

A double contact voltage regulator and a field relay are the principal parts of this assembly. The voltage regulator unit limits the voltage output. The field relay unit connects the generator field winding and regulator winding to the battery.

The regulator internal circuits are shown on the wiring diagram, Fig. 6-9. When the ignition switch is in the "ON" position, the tell-tale generator lamp glows to indicate that the generator is not charging. Current then flows from the positive battery terminal, through the battery terminal on the switch, through the indicator lamp and resistance wire (which are in parallel), and on to the regulator No. 4 terminal.

Within the regulator unit, current flows through the lower set of voltage regulator contacts to the "F" terminal. Current then flows through the generator field winding to ground. Enough current is thus supplied to the field winding to insure that the stator winding voltage is built up when the engine starts.

As the generator begins to operate, voltage from the "R" or relay terminal of the generator flows to the regulator No. 2 terminal, causing the field relay contacts to close. This connects

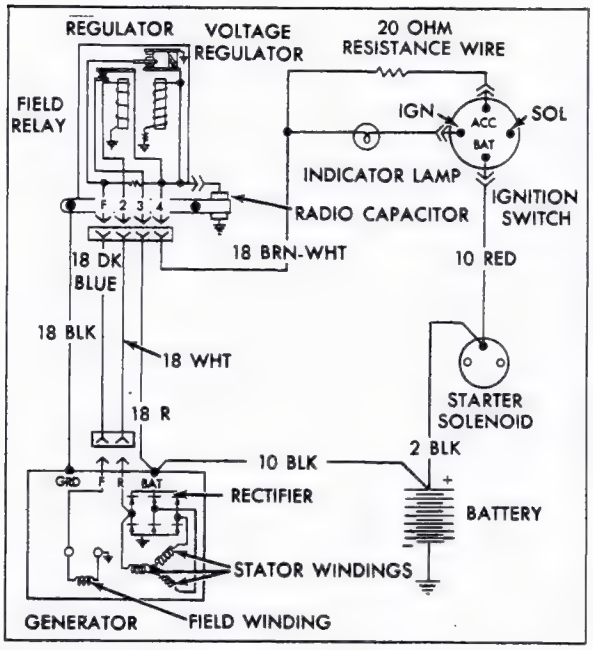


Fig. 6-9 Basic Charging Circuit

the regulator No. 4 terminal directly to the battery through the field relay contacts, which applies system voltage to the regulator side of the tell-tale indicator lamp. With equal system voltage on the battery side of the indicator lamp, there is no current flow and the indicator lamp will go out. Generator field current then flows from the generator output terminal to the regulator No. 3 terminal and through the field relay contacts and the voltage regulator lower contacts to the field winding.

As the generator rpm increases, the voltage at the "BAT" or output terminal also increases. This impresses a higher voltage through the field relay contacts and across the voltage regulator shunt winding. The magnetic field developed in the winding causes the lower, or series, contacts of the voltage regulator to separate. The generator field current then flows to ground through a resistor that reduces field current.

This reduced field current causes the generator voltage output to decrease, thereby decreasing the magnetic pull of the voltage regulator shunt winding. A spring overcomes the weakened magnetism and closes the contacts. This cycle repeats itself many times per second to limit the generator voltage to the pre-set value.

As the generator speed increases even further, the resistor connected across the contacts is not large enough to maintain voltage control. However, when the voltage increases slightly above the setting, this causes the upper or "shorting" contacts to close. When this happens, the generator field winding is shorted so that no current passes through the winding.

With no current in the field winding, the generator voltage output decreases sharply. This reduces the magnetic field in the shunt winding and allows the upper contact points to open. With these points open, field current again flows through the resistor and the field winding. As the voltage increases, the contacts again close. This cycle repeats many times per second to limit the generator voltage to the pre-set value at high generator speeds.

The voltage regulator unit operates to limit the value of the generator voltage throughout the entire generator speed range, protecting all electrical units and accessories from too high a voltage, which could damage them. The self-limiting current output feature of the generator eliminates the need for a current regulator.

Regulator (With 63 Amp Generator Only)

The voltage regulator used with the optional 63 amp generator is similar to the regulator described above except for the addition of a field discharge diode located in parallel between the voltage regulator contacts and the regulator "F" terminal. The field discharge diode permits the voltage regulator points to handle the additional current of this generator safely. This unit should, therefore, always be replaced with another of the same type. Do not attempt to operate this system with a standard regulator.

Generator (Optional on Commercial Chassis Only)

The optional heavy duty generator for the commercial chassis is mounted at the right front side of the engine on special brackets. This special 130 ampere generator is not available as an option on other models.

The generator consists primarily of a drive end frame, a slip ring end frame, a stator assembly and a rotor assembly.

The rotor is mounted on ball bearings at each end. Each bearing has a grease reservoir that eliminates the need for periodic lubrication. Two burshes carry current through the two slip rings to the field coils wound on the rotor.

The stator windings are assembled on the inside of a laminated core that forms the generator frame. Six rectifier diodes are mounted in the slip ring end frame and are connected to the stator windings.

This generator also features three A.C. terminals in addition to the "BAT" terminal. A transformer may be connected to the A.C. terminals to step up the A.C. voltage. The high A.C. voltage, usually 110-120 volts, may be rectified to provide 110-120 volts D.C.

Regulator (Commercial Chassis With Heavy Duty Generator Only)

The transistor regulator illustrated in Fig. 6-33, limits the voltage developed by the heavy duty generator, by regulating the field current.

This regulator is used with an ammeter. The generator field current is supplied to the regulator from the battery through the ignition switch.

Field current is provided in this manner for initial generator voltage build-up.

The transistor is an electrical device made of semi-conductor materials used as a switch to control the generator field current. Fig. 6-34 is a diagram of the generator and regulator circuit. A brief description of the operation follows:

When the ignition switch is closed, battery voltage supplies current through the emitter (E) and collector (C) of the transistor to the field coil of the generator. Thsi emitter-collector circuit is complete since the transistor is turned "ON" by a higher voltage on the emitter than on the base (B), which permits emitter-base current to flow. The flow of current to the field circuit of the generator provides the magnetic field for the generator. When the engine is started, the generator builds up voltage. This causes current to flow to charge the battery and power the electrical devices.

As generator speed increases or the load decreases, generator voltage builds up to the regulator setting. The electrical control portion of the regulator then places a higher voltage on the base of the transistor than is impressed upon the With no current flow in the emitter-collector circuit, there is no current flow in the field coil of the generator, and generator voltage drops below the setting.

The electrical control portion of the regulator then provides a lower voltage on the base of the transistor than that on the emitter, and the transistor is again turned "ON". With current flow again in the emitter-collector and field coil circuit, the magnetic field is reestablished in the generator, and generator voltage again builds up to the setting of the regulator.

This switching "ON" and "OFF" of the transistor regulates the amount of field current supplied to the generator. The frequency of this switching depends primarily upon the electrical load and generator speed. Under certain conditions the "ON" and "OFF" cycle is repeated as much as 7,000 times per second.

This voltage regulator has no moving mechanical parts. It is sealed to make it highly water resistant. An external adjustment is provided. Adjustment can be made without removing the regulator cover, and without the warm-up periods necessary on many regulators.

SERVICE INFORMATION

BATTERY

The following battery service information applies to all 1969 Cadillac vehicles.

12. Battery Filling Instructions

The battery electrolyte level should be checked at every engine oil change. In warm weather, a check should be made at two-week intervals. An electrolyte level indicator vent cap is located in the second cell cap from the positive battery post. With the use of this vent cap, it is not necessary to remove cell vent caps when checking fluid level. A dark (black) spot in the center of this vent cap is visible when electrolyte is at the normal level. If at any time the electrolyte level drops below normal, the spot changes from black to an off-white color. When an off-white condition is encountered, all cell levels must be adjusted to their correct level. This is accomplished by raising the fluid level to the bottom of the slot in each cell with colorless, odorless drinking water.

CATUION: Do not overfill battery or add any substance to fluid except colorless, odorless drinking water.

13. Battery Visual Inspection

1. Inspect positive battery cable and negative ground cable for corrosion or damage.

2. Inspect metal carrier for corrosion. If corrosion exists, it wil be necessary to remove retainer and battery from car and pour warm soda or ammonia water over corroded areas to loosen the corrosion so that it can be brushed off and flushed away.

3. The hold-down retainer should be inspected to see that it is tight enough to prevent the battery from shaking in its holder and damaging the battery case.

4. The battery posts and terminals should be inspected for corrosion. If they are corroded, wipe off the posts and terminals with a cloth dampened with household ammonia, or with a solution of water and baking soda. These alkaline solutions will neutralize any acid on parts being cleaned.

CAUTION: Care should be taken to keep cleaning solution out of battery cells; otherwise, the electrolyte will become permanently weakened.

5. Examine battery for cracks in case and excessive looseness in battery tray.

6. Check electrolyte level. Add only colorless, odorless drinking water as necessary to bring electrolyte level to bottom of the slot in each cell.

7. If no visual defects are found, proceed to Note 14.

14. Testing Battery Condition

A battery testing instrument, designated a "421 Tester", is recommended to test the solid top batteries of all 1969 Cadillac vehicles. These "421" Testers, manufactured by several test

equipment companies, will quickly determine the condition of a battery relative to state of charge and ability to provide satisfactory performance.

NOTE: Do not charge batteries prior to making test. Be certain to obtain clean and tight connections before performing the "421" test.

1. Perform "421" battery test following instructions on your particular test instrument.
2. Batteries designated Bad by "421" Tester should be replaced.
3. Batteries designated Good by "421" Tester may be returned to service if there is no owner complaint or other indication of poor performance.
4. Batteries designated Good by "421" Tester, but are questionable in service because of owner complaint or age of battery, should be further tested by a hydrometer as outlined in Notes 15 and 16

15. Use of Hydrometer

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. An indication of the concentration of the electrolyte is obtained with a hydrometer.

The specific gravity of the electrolyte varies not only with the percentage of acid in the liquid but also with temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contracts so that the specific gravity incresase. Unless these variations in specific gravity are taken into account, of acid in the electrolyte.

Correction can be made for temperature by adding .004, usually referred to as four "points of gravity", to the hydrometer reading for every 10° F. that the electrolyte is above 80°F. or subtracting .004 for every 10°F. that electrolyte is below 80°F. Fig. 6-10 shows the exact correction figure to use for any temperature above or below 80°F., the three steps used in obtaining the corrected or true specific gravity, and two examples showing how it is determined.

If the electrolyte temperature is not too far from the 80°F. standard, or if only an approximate idea of specific gravity reading is required, it will not be necessary to make the temperature correction. Hydrometers are available which have a built-in thermometer and temperature correction scale similar to Fig. 6-10. This type of hydrometer simplifies obtaining a true specific gravity reading.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out to insure an accurate reading.

2. Hydrometer readings must never be taken immediately after water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 15 minutes at a rate high enough to cause vigorous gassing.

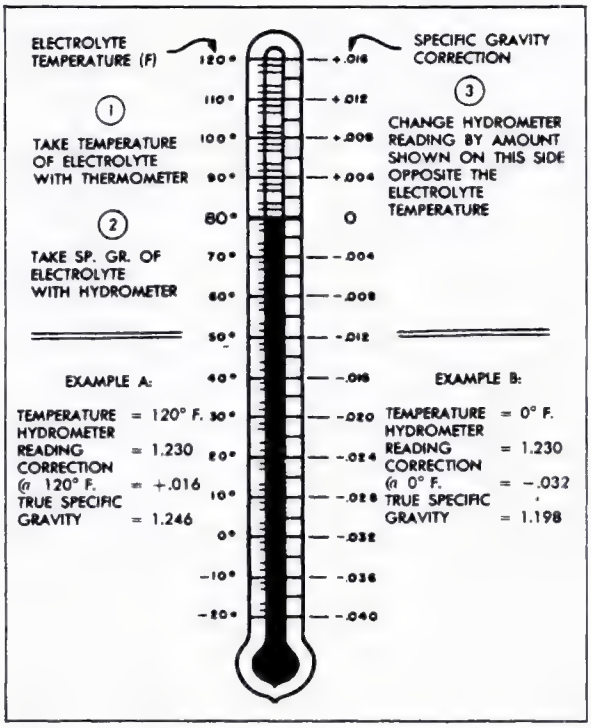


Fig. 6-10 Specific Gravity Temperature Correction Scale

3. If hydrometer has built-in thermometer, draw liquid into it several times to insure correct temperature before taking reading.

4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvature where the liquid rises against float stem due to surface tension.

5. Avoid dropping battery fluid on car or clothing as it is extremely corrosive. Any fluid that drops should be washed off immediately with baking soda solution.

16. Specific Gravity Cell Comparison Test

1. Measure the specific gravity of each cell in the battery and the temperature of one of the center cells. Interpret readings as shown below.

NOTE: If the electrolyte level is too low to be checked by a hydrometer, adjust electrolyte to the proper level by adding colorless, odorless drinking water. After water addition, the specific gravity check cannot be made until the battery is charged at a rate high enough to cause vigorous gassing for a period of 15 minutes of more. This insures that added water is mixed with the electrolyte before a specific gravity reading is taken.

2. When the specific gravity of the electrolyte falls within the 50 point variation between cells and the 1.230 to 1.310 specific gravity range, the battery is ready for use.

3. If any cell reads less than 1.230 and battery has been in service three months or less, battery is good, but it has been improperly filled with electrolyte or water and will give poor performance. To correct this condition, empty the electrolyte from the cell reading less than 1.230 and refill with electrolyte having a specific gravity of 1.265.

4. If any cell reads less than 1.230 and the battery has been in service more than three months, it should be replaced.

5. If any cell reads above 1.310, the battery may be returned to service. However, specific gravities above 1.310 are harmful to the battery and will cause an early failure. Such high readings are caused by the improper addition of electrolyte. Adjusting the specific gravity by pouring out the old solution and replacing it with electrolyte of the correct specific gravity will not correct the damage that has been done.

Specific Gravity Difference Between Highest and Lowest Cells	Specific Gravity of Lowest Cell (Temp. Corrected)	Interpretation
Less than 50 points	More than 1.230	Good battery (1) - Satisfactorily charged
Less than 50 points	Less than 1.230	Good battery (1) - Requires charging
50 points or more	—	Defective battery - Replace

(1) Fully charge and re-test those batteries that pass the specific gravity test but fail to perform satisfactorily. Any cell indicating a specific gravity reading (corrected for temperature) of less than 1.230 means that the battery is defective and should be replaced.

17. Causes of Low Battery Conditions

Common causes of low battery conditions other than those due to a defective battery are listed below, and should be investigated when there are indications that the car has a consistently low battery.

1. Excessive use of accessories with the engine not running.
2. Leaving lights on or doors open.
3. Improper installation of accessories.
4. Generator belt loose.
5. Incorrect regulator settings. These can be corrected and set, preferably toward high limit, as explained in Note 39.
6. Oxidized regulator contact points.
7. Self-discharge resulting from a dirty battery case.
8. Loose battery cables.
9. Low generator output, which may be checked and corrected as explained in Note 35.
10. A partial ground in positive side of battery circuit. With clock disconnected and all switches in "Off" position, a milliameter or voltmeter connected in series between battery positive post and battery cable should indicate zero.
11. High resistance in charging circuits.

18. Battery Removal and Installation (All Except 693)

a. Removal

1. Disconnect negative and positive battery cables at battery by spreading spring type clamps at battery post with pliers. Lift clamps off posts and position cables out of way.

CAUTION: Do not spread cable clamps any more than necessary. Do not pry clamps off battery posts.

2. Remove retaining screw from radiator cradle at release rod.
3. Release battery by moving release lever out from under clip and moving to front of battery tray.
4. Remove battery by lifting straight up.

b. Installation

1. Position battery in battery tray with posts toward rear of cradle (positive terminal near radiator).
2. Clean all corrosion from battery posts and cable clamp terminals.
3. Position battery to rear of tray so that retainer tab of battery tray is positioned in groove in lower rear of battery. Move locking rod into position under clip.
4. Install one screw in radiator cradle so that it locks rod in place.
5. Connect positive battery cable first, then negative cable. Spread clamps with pliers and push them onto battery posts as far as possible. When installed, clamps should be from flush to 1/8 inch below top of post.

CAUTION: Do not drive clamps onto battery post with hammer or other tool. The spring ring inside the clamp should never be reamed or cut.

6. Apply a light coat of oil or grease to the clamp terminals.

19. Battery Removal and Installation (693 Only)

a. Removal (Fig. 6-8)

1. Disconnect negative and positive battery cables at battery by spreading spring clamp with pliers, and lift clamps off post.

CAUTION: Do not spread cable clamps any more than necessary and do not pry clamps off battery post.

2. Remove screw and retainer holding locking rod to radiator cradle.

3. Push locking rod, at rear of radiator support, toward engine (approximately four inches) and remove battery, being careful not to damage posts.

b. Installation (Fig. 6-8)

1. Clean all corrosion from battery posts and cable clamp terminals.

2. Position battery on battery tray. Slide battery all the way forward so that retainer tabs are positioned in grooves near bottom of battery.

3. Move locking rod, at rear of radiator support to vertical position next to support, Fig. 6-8.

4. Secure locking rod to radiator cradle with clamp and screw.

5. Connect positive battery cable first, then negative cable. Spread clamps with pliers and push them onto battery posts as far as possible. When installed the clamps should be from flush to 1/8 inch below top of post.

CAUTION: Do not drive clamps onto battery posts with hammer or other tool. The spring ring inside the clamp should never be reamed or cut as this will damage it.

6. Apply a light coat of oil or grease to the clamp terminals.

20. Care of Batteries Not in Use

Batteries in cars that are being stored require special care to prevent plate sulphation or other deterioration due to chemical action.

Before a wet charged battery is stored, an inspection should be made to see that it is filled to the proper level and that it is fully charged (1.250-1.280).

Wet batteries in storage should be checked every 30 days and given a boost charge of 25 per cent of the ampere hour capacity of the battery at a rate of 5 amperes.

STARTING SYSTEM

21. Starter Motor Circuit

The starter motor is engaged when the ignition key is turned to the extreme right position. Engagement is obtained by means of a solenoid, Fig. 6-11 attached to the starter housing. The solenoid first engages the starter pinion with the flywheel gear and then closes the main switch so that the battery current is delivered to the starter motor.

The starter solenoid is drawn into the engaged position by both the pull-in coil and the hold-in coil, and held in position by the hold-in coil only, Fig. 6-11. The contact bar at the end of the solenoid completes a direct circuit between the battery and the starter motor, energizing the starter motor and shorting out the pull-in coil.

The current consumption of the solenoid switch should be 41-47 amperes at 10 volts for both windings, and 14.5 - 16.5 amperes at 10 volts for the hold-in winding alone.

22. Starter Motor Maintenance

Lubrication—When the starter motor is disassembled for service, apply a light coating of lubricant (available from your servicing Parts Distribution Center) on the bushings in the end bearings. Avoid excessive lubrication, as this might force lubricant out onto the commutator where it would gum and cause high resistance, resulting in poor starter motor performance. Never lubricate the commutator.

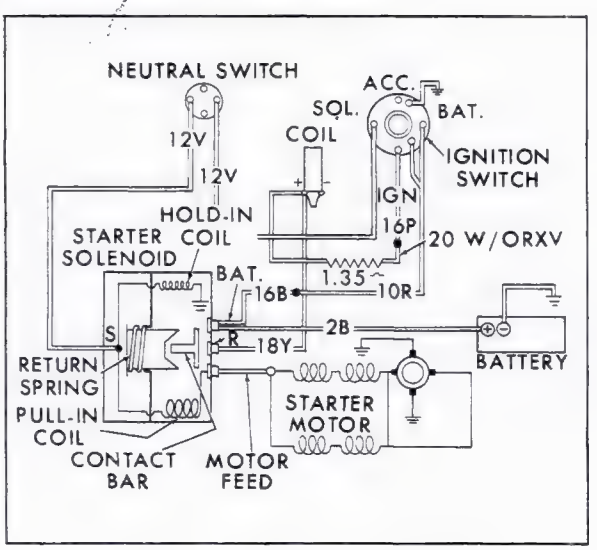


Fig. 6-11 Starting System Circuit

23. Starter Motor Circuit Resistance Test

a. Battery Cable and Starter Switch Test— Insulated Circuit Test

This test measures the resistance of the cables and switches that feed the starter motor. The heavy current used by the starter motor will produce a voltage drop in the wiring which can be measured as an indication of this resistance. The battery should be fully charged.

1. Disconnect primary lead of distributor from coil so engine will not start.

CAUTION: Do not remove high tension lead from coil center for this purpose, as this may damage the coil due to internal arcing.

2. Using Battery Starter Tester, turn voltmeter selector switch to 16 volt scale.
3. Connect starter solenoid remote switch and test leds as shown in Fig. 6-12.
4. Connect positive voltmeter lead to center of positive battery post, on which insulated battery cable is connected. Connect negative voltmeter lead to starting motor terminal, Fig. 6-12.
5. Close starter solenoid remote switch, and turn voltmeter to 4 volt scale while cranking. Observe reading, and immediately turn meter back to 16 volt scale.
6. Voltmeter should show .6 of a volt or less while engine is being cranked. If voltage drop is more than .6 of a volt, it is an indication that the cables or connections are dirty or corroded, the solenoid switch is defective, the battery is in a low state of charge, the starter motor is drawing too much current, or that the engine is too tight.
7. If voltage drop across the entire insulated side of the battery starter circuit exceeds the specified .6 volt, test the individual parts of the insulated circuit for excessive resistance. Maximum voltage drop for each should not exceed the following specifications:

a. Battery to Solenoid Switch	.4 volt
b. Across Solenoid Battery Terminal	.2 volt
c. Solenoid Switch to Starter Terminal	Zero

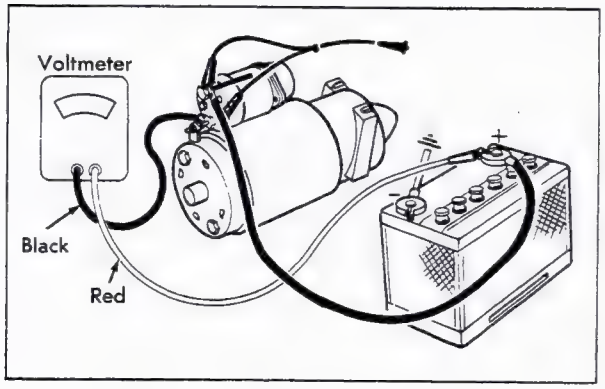


Fig. 6-12 Battery Cable to Starter Test

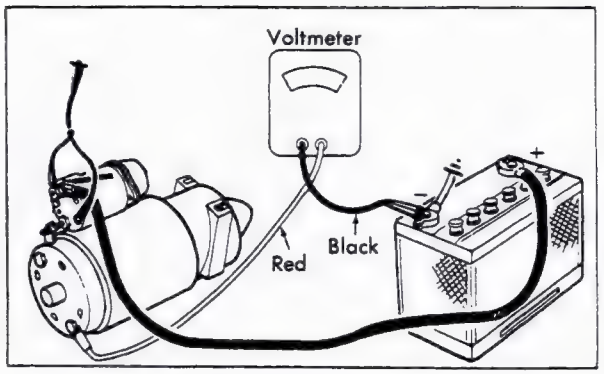


Fig. 6-13 Ground Circuit Test

b. Ground Circuit Test

1. Turn voltmeter selector switch of Battery Starter Tester to 4 volt position.
2. Connect test leads as shown in Fig. 6-13.
3. Connect starter solenoid remote switch as shown in Fig. 6-13.
4. Connect negative voltmeter lead to a clean spot at center of negative battery post, not to the cable clamp.
5. Connect positive voltmeter lead to the starting motor through bolt.
6. With starter motor cranking engine, voltage drop should not exceed .3 volt. A reading of more then .3 volt is usually an indication of resistance due to loose, dirty, or corroded connections.
7. Connect primary lead of distributor to coil.

24. Checking Starter Motor Pinion Clearance

a. Preferred Method (Fig. 6-14)

1. Remove starter motor from car as described in Note 26.
2. Energize solenoid by applying 6 volts between solenoid "S" terminal and ground.

CAUTION: Do not use more than 6 volts or motor will operate. As a further precaution, connect a heavy jumper wire from the solenoid motor terminal to ground.

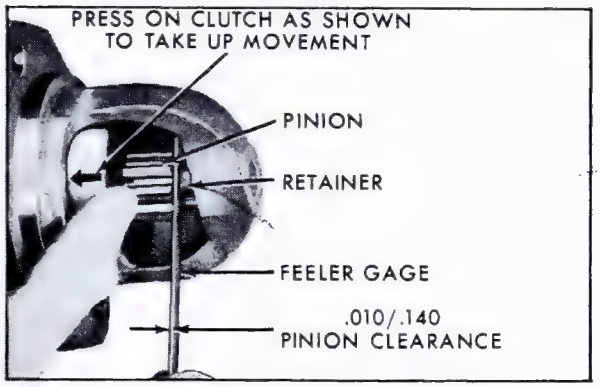


Fig. 6-14 Checking Pinion Clearance

3. After energizing solenoid, press on clutch, Fig. 6-14, to take up movement.

4. Push pinion away from stop retainer as far as possible and use feeler gage to check clearance between starter motor pinion and pinion stop retainer, Fig. 6-13. Clearance should be .010 inch to .140 inch when pinion is in cranking position.

b. Alternate Method (Fig. 6-14)

If a six volt battery is not available, pinion clearance may be checked with a 12 volt battery in the following manner:

1. Remove starter motor from car as described in Note 26.

2. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.

3. Connect a 12 volt battery from the solenoid switch terminal to the solenoid frame.

4. Momentarily connect a jumper lead from the solenoid motor terminal to the solenoid frame. This will shift the pinion into cranking position and hold it there until the battery is disconnected,

5. After energizing solenoid, press on clutch, Fig. 6-14, to take up movement.

6. Push pinion away from stop retainer as far as possible and use feeler gage to check clearance between starter motor pinion and pinion stop retainer, Fig. 6-14. Clearance should be .010 inch to .140 inch when pinion is in cranking position.

NOTE: Pinion clearance cannot be adjusted. If clearance is incorrect, disassemble starter motor and check for excessive wear of solenoid linkage, shift lever mechanism or improper assembly of these parts. All worn parts must be replaced.

25. Checking Inoperative Starter Motor

If starter motor cranks engine slowly or not at all, check battery, battery terminals and connections, ground cable, and battery-to-starting motor cable. Corroded, frayed, or broken cables should be replaced, and loose or dirty connections corrected.

The overrunning clutch should withstand 80 to 85 foot-pounds torque without slipping. The pinion should turn freely and smoothly in the overrunning direction. The solenoid switch contacts should be checked for a burned conditions, and the contact disc and terminal studs should be replaced if necessary.

Inspect brushes and commutator. Brushes should form a good contact with commutator and have the correct spring tension. If there are burned bars in the commutator, it may indicate open circuited armature coils that may prevent proper cranking. Inspect soldered connections at commutator rise bars, and resolder any damaged connections.

Tight or dirty bearings will reduce armature speed or prevent the armature from turning. A worn bearing, bent shaft, or loose pole shoe will allow armature to drag, causing slow speed or failure of the armature to rotate. Check for these conditions.

26. Starter Motor—Removal and Installation

a. Removal

1. Disconnect negative battery cable at battery.
2. Raise front end of car.
3. Disconnect battery lead at starter solenoid terminal.
4. Disconnect neutral switch wire and coil feed wire at starter solenoid terminals.
5. Remove spring clip securing wire to solenoid housing.
6. Remove screw and nut securing support bracket to starter and crankcase.
7. Remove two screws that hold starter motor to flywheel housing.
8. Remove starter motor by pulling it forward and then lowering it straight down.

b. Installation

1. Position starter motor in proper location in flywheel housing.
2. Install two screws holding starter motor to flywheel housing. Tighten screws to 46 foot-pounds.
3. Install starter motor support bracket and secure with screw and nut. Tighten screw to 12 ft. lbs. and nut to 70 in. lbs.
4. Connect battery lead, coil feed wire, and neutral safety switch wire to starter solenoid terminals.
5. Install spring clip securing solenoid wires to solenoid housing.
6. Connect negative battery cable to battery.

27. Starter Motor—Disassembly and Assembly

When the starter motor is disassembled for cleaning and inspection of parts, the overrunning clutch, armature, and fields should not be cleaned in a degreasing tank, or with grease disssolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. Worn parts should be replaced, and the commutator should be turned down in a lathe if necessary.

a. Disassembly (Fig. 6-15)

1. Disconnect field coil connector from solenoid motor terminal.
2. Remove two screws and lockwashers that hold solenoid switch assembly to starter drive housing and remove solenoid and solenoid return spring by rotating solenoid assembly counterclockwise to release solenoid flange from center frame.
3. Remove two through bolts.

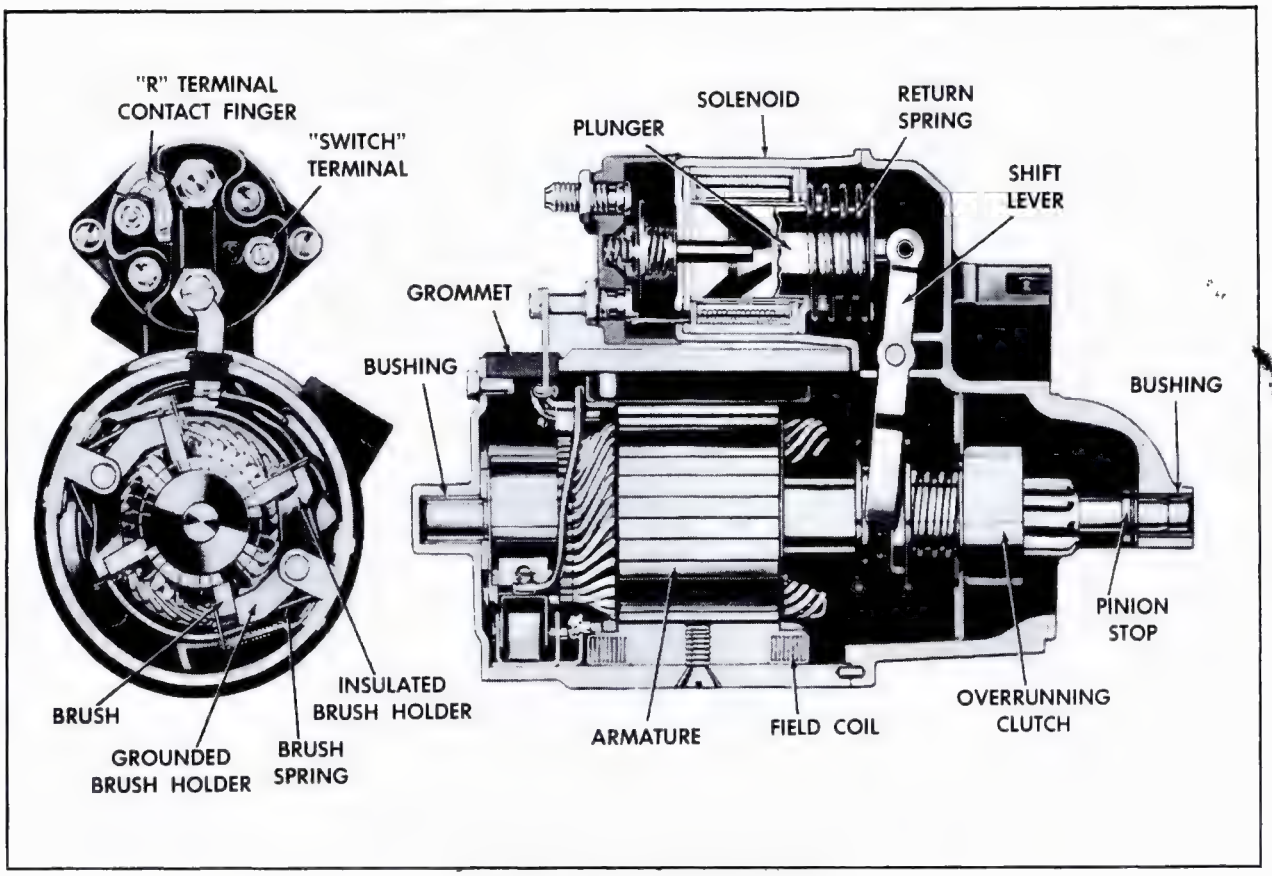


Fig. 6-15 Starter Cut-Away View

4. Remove commutator end frame and leather brake washer.

5. Remove center frame assembly.

6. Remove snap ring that holds shift lever pivot pin, using snap ring pliers, J-4880, and remove pivot pin from drive housing.

7. Remove plunger and shift lever assembly and armature assembly with overrunning clutch from drive end housing.

8. Remove overrunning clutch from armature shaft as follows:

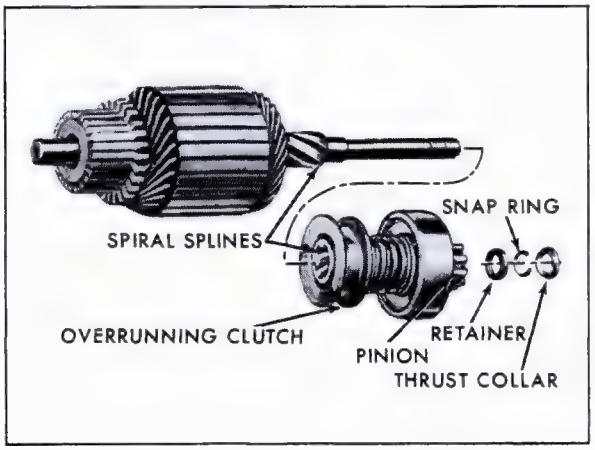


Fig. 6-16 Starter Armature Assembly

a. Slide thrust collar off end of armature shaft, Fig. 6-16.

b. Slide a standard 3/8" pipe coupling or 5/8" deep well socket onto shaft so end of coupling or socket butts against edge of retainer, Fig. 6-16. Tap end of coupling or socket with hammer, driving retainer toward armature and off snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If snap ring is badly distorted during removal, it will be necessary to use a new one when assembling shaft.

d. Slide retainer and clutch assembly from armature shaft.

9. To disassemble solenoid, proceed as follows:

a. Remove two screws with neoprene washers and nut with neoprene washer from switch terminal.

b. Remove contact cover.

c. Remove push rod assembly.

d. Inspect push rod assembly and contact studs for damage or wear. Contact assembly cannot be broken down further and must be replaced as a unit if found defective.

e. To replace contact studs, hold stud while removing nut to be sure stud does not turn.

b. Assembly

1. To assemble solenoid, proceed as follows:

a. Install contact studs, holding studs while tightening nut to be sure stud does not turn.

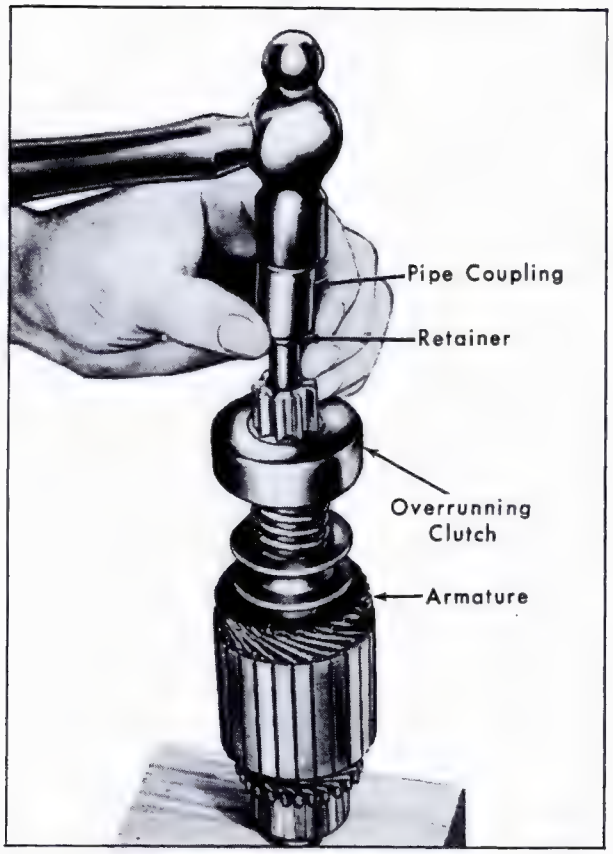


Fig. 6-17 Removing Overrunning Clutch

b. Install push rod assembly.

c. Install contact cover with switch terminal stud through square hole. Secure with two screws with plastic washers and lock nut with plastic washer on switch terminal stud.

2. Assemble overrunning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with a few drops of SAE 30W oil.

b. Slide clutch assembly onto armature shaft with pinion outward, Fig. 6-17.

c. Slide retainer onto shaft with cupped surface facing end of shaft, Fig. 6-17.

d. Stand armature on end of a wood surface with commutator down. Position snap ring on upper end of shaft and hole in place with either a piece of wood or a 7/16" socket. Tap socket or block with hammer to force snap ring on end of shaft, Fig. 6-18. Slide snap ring down to the second groove.

e. Assemble thrust collar on shaft with shoulder next to snap ring, Fig. 6-19.

f. Position retainer and thrust collar next to snap ring. Using two pairs of pliers, grip retainer and thrust collar and squeeze until snap ring is forced onto retainer, Fig. 6-19.

3. Place a small quantity of high melting point grease in drive end housing grease retainer.

4. Position legs of shift lever assembly in grooves of overrunning clutch. Install armature and overrunning clutch assembly into drive end

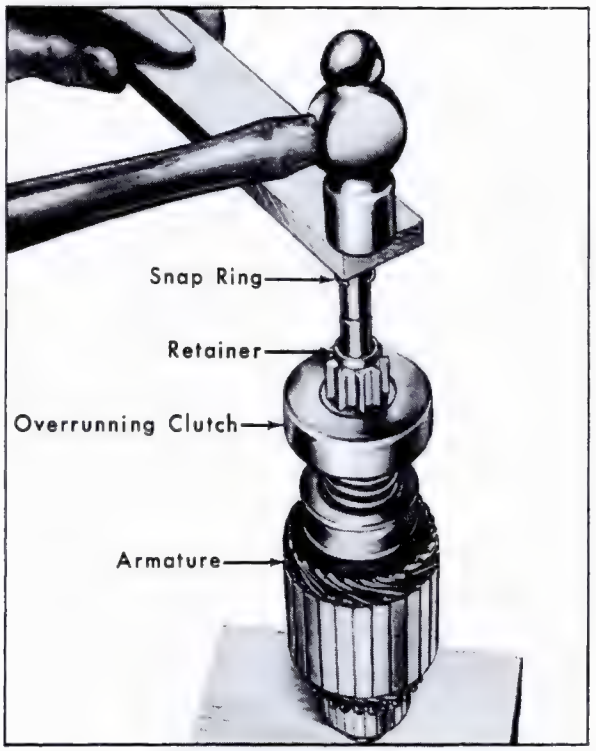


Fig. 6-18 Installing Snap Ring on Shaft

housing, making certain that thrust washer is in place on end of shaft.

5. Install shift lever pivot pin into recess in housing and secure with snap ring, using Snap Ring Pliers, J-4880.

6. Mount starter in a vise and install solenoid return spring and solenoid switch assembly. Secure with two attaching screws and lock washers.

7. Apply a non-hardening sealing compound to area where center frame will contact solenoid case flange.

8. Install center frame assembly on drive end housing by starting assembly over armature, spreading brush holders apart to engage commutator and mating dowel pin on frame with dowel pin hole in drive end housing.

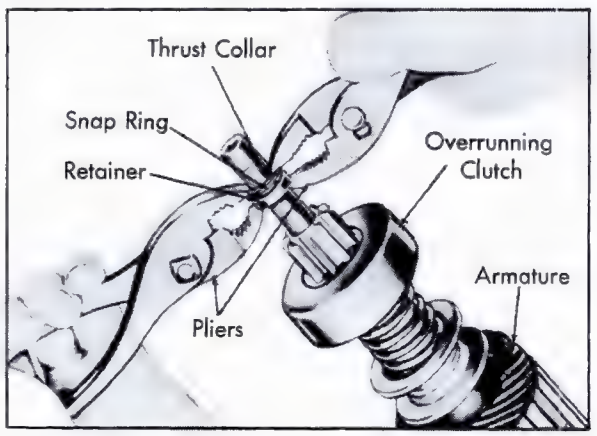


Fig. 6-19 Installing Snap Ring on Retainer

9. Place a small quantity of high melting point grease on bushing in commutator end frame.
10. Place leather brake washer on armature shaft.
11. Slide commutator end frame on shaft and secure with two through bolts.
12. Install field coil terminal connector on solenoid motor terminal, securing with self-tapping screw and star washer.

28. Starter Motor Inspection and Testing

Starter must be removed from car, Note 26, and disassembled, Note 27, to perform tests.

a. Visual Inspection

CAUTION: The overrunning clutch, armature, and fields should not be cleaned in a degreasing tank, or with grease dissolving solvents, since solvents would dissolve lubricant in clutch mechanism and damage the insulation in armature and field coils.

1. Test overrunning clutch action. Pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked or excessively worn. Replace clutch assembly if necessary.
2. Check bearings for signs of tightness, dirt or wear. Check for a bent armature shaft or a loose pole shoe screw.
3. Check brush holders to see that they are not deformed or bent so that brushes bind in their holders. Brush holders should be clean.
4. Check brushes for wear or damage in normal service. If worn down to one-half original length, brushes should be replaced.
5. See if full brush surface rides on the commutator when assembled, and if there is proper spring tension to give good firm contact. Replace weak brush springs.
6. Check brush leads and screws to be certain they are tight and clean. Clean leads, if necessary, and check tightness of screws.
7. Brush holding parts are replaced only if necessary, in the following manner:
   a. Remove brush holder pivot pin.
   b. Remove brush spring.
   c. Replace brushes by removing attaching screw, installing a new brush and securing with attaching screw. Trade name will be visible when brushes are correctly installed.
   d. Install brush spring by inserting it in slot in center frame.
   e. Install insulated brush and grounded brush, and secure with pivot pin.
8. Check fit of armature shaft in drive housing and in commutator end frame. Shaft should fit snugly in both bushings. If bushing in drive housing is worn, it will be necessary to replace the drive housing. If bushing in commutator end frame is worn, replace commutator end frame.
9. Inspect leather brake washer for damage, and replace, if necessary.

b. Checking Armature for Shorts

1. Place armature in growler. Lock armature in position by securing clamp on the commutator. Turn ON-OFF switch on.
2. Rotate armature while holding steel strip that comes with the tester near the armature. Steel strip will vibrate in the area of a short circuit. Turn off switch.
3. Shorts between bars are sometimes produced by brush dust or copper between the bars. Inspect for this condition. Have commutator insulation undercut to eliminate these shorts.

c. Checking Armature for Opens

1. Inspect the points where conductors are joined to the commutator for loose connections. Poor connections can cause arcing and burning of the commutator.
2. If bars are not badly burned, resolder leads in riser bars. Have commutator turned down in a lathe. Have insulation between the commutator bars undercut 1/32".

d. Checking Armature for Grounds

Check for gounds with aid of a 110-volt test lamp.
1. Remove armature from armature tester and place on bench.
2. Place one test lamp lead on the commutator.
3. Touch other test lamp lead to armature core and then armature shaft. If lamp lights, the armature is grounded.

If the commutator is worn, dirty, out of round, or has high insulation, a ground condition may result. If a ground is indicated, have commutator turned down in a lathe and insulation between the commutator bars undercut 1/32".

e. Checking Field Coils for Grounds

Check field coils for grounds and opens, using 110-volt test lamp.
a. Connect one lead of test lamp to motor feed terminal and other to any clean surface of field frame. Lamp should not light.

If lamp lights, field coils are grounded and must be replaced.

f. Checking Field Coils and Insulated Brush Holder Leads

1. With center frame assembly positioned so that brush holders are on top, push upper motor feed terminal from center frame assembly.
2. Touch one test lamp lead to each of motor feed terminals. Lamp should light. If it does not light, there is an open in field coils and field coil assembly must be replaced.
3. If the lamp lights, perform Step 4 to check insulated brush holder leads.
4. Hold one test lamp to either motor feed

terminal. Touch other lead in turn to two pigtail leads of insulated brushes. Lamp should light.

If lamp does not light in either instance, leads should be repaired by soldering. Be sure to install upper motor feed in grommet.

CHARGING SYSTEM (All Except Commercial Chassis With Heavy Duty Generator)

The following procedures apply to the charging system found on all 1969 Cadillac cars. The Commercial Chassis is available with a 130 amp rated generator in conjunction with a transistor regulator as an option. The circuit for this system is quite different from the one described here. For checking and adjusting procedures on this optional Commercial Chassis charging system, refer to Notes 40 to 47.

29. Charging Circuit Precautions—Applies to All Charging Systems

When performing any tests or adjustments on the charging circuit there are certain precautions that must be observed or serious damage will result to the electrical equipment.

1. Do not attempt to "polarize" the generator.
2. Do not short across or ground any of the terminals on generator or regulator.
3. Never operate generator on open circuit. Make certain all connections are secure.
4. Make certain ground polarity of battery and ground polarity of generator are the same when installing a battery.
5. When connecting a booster battery, make certain to connect the negative battery terminals together and positive terminals together.
6. When connecting a charger to battery, connect charger positive lead to battery positive terminal and charger negative lead to battery negative terminal.
7. When recharging battery in the vehicle, be sure engine is turned off when battery terminal connections are made. This will prevent arcing at the terminals which could cause an explosion at the battery.
8. Remove battery cap cover and make sure caps are tight before connecting battery cables.
9. Make sure all electrical accessories are turned off when making battery connections.

30. Preliminary Charging Circuit Checks

Visually check the charging circuit for the following:

1. Frayed insulation or wiring.
2. Tightness of mounting bolts.
3. Corroded or loose connections at generator terminals and slip-on connectors at regulator terminals.

31. Analyzing Charging System Troubles

Trouble in the charging system, Fig. 6-20, will usually show up as one or more of the following conditions:

a. Indicator Lamp Operation

The indicator lamp should light when the ignition switch is turned to the "on" position, and the engine is not running. Lamp should also glow dimly when the ignition switch is in the "ACC" position. In addition, the lamp may flash brightly when the engine is turned off.

If the indicator light fails to operate as described above, refer to indicator lamp checking procedures, Note 32.

b. Undercharged Battery (Evidenced by Slow Cranking)

If battery is consistently undercharged, refer to Note 32.

c. Overcharged Battery (Evidenced by Excessive Water Usage)

1. Check for a defective battery as covered in Notes 14 and 16.
2. If battery is not defective, voltage regulator setting is probably too high. Refer to Note 41.

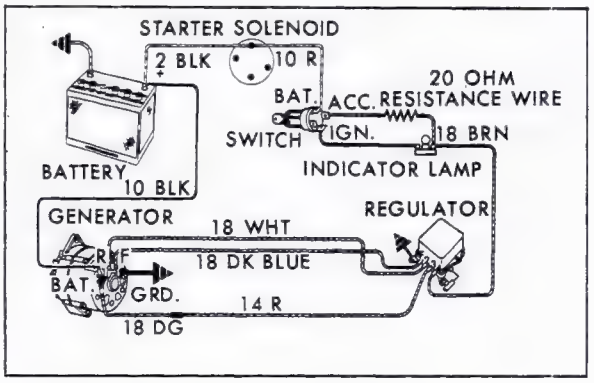


Fig. 6-20 Basic Charging Circuit

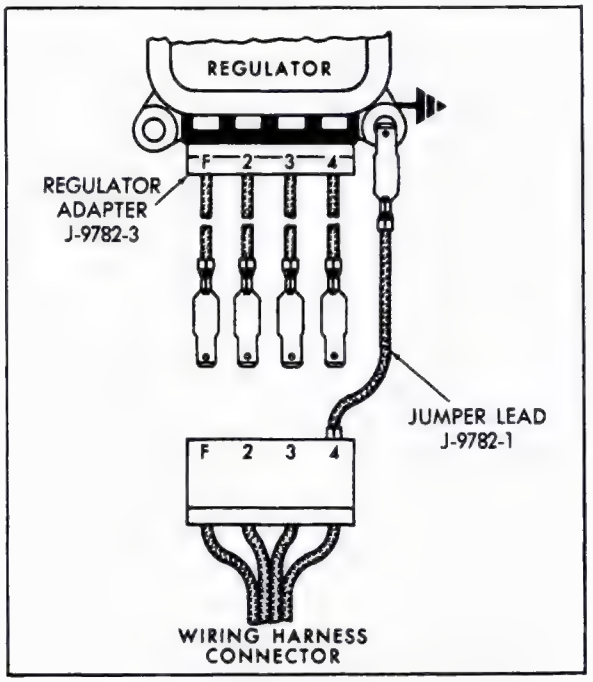


Fig. 6-21 Testing Indicator Lamp Circuit

32. Testing Indicator Lamp Circuit

a. Lamp Does Not Light With Ignition In "ON" Position

1. Disconnect wiring harness connector at regulator.

2. Insert jumper lead, J-9782-1, into wiring harness and connect as shown in Fig. 6-21.

3. Turn ignition switch "ON" for not more than 10 seconds.

NOTE: With these connections made for longer than 10 seconds damage to the 20 ohm resistance wire may result.

4. If lamp does not glow, check for a burned out bulb, defective #4 terminal wire, or a defective printed circuit as described in Section 12, Note 54.

5. If lamp does glow, remove ground and connect as shown in Fig. 6-22.

6. If lamp glows, replace regulator or adjust voltage regulator setting. If lamp does not glow, leave connections as shown in Fig. 6-22 but connect a second jumper wire from generator "F" terminal to ground.

7. If lamp does not glow, "F" terminal lead is open. If lamp glows, field circuit inside generator is open.

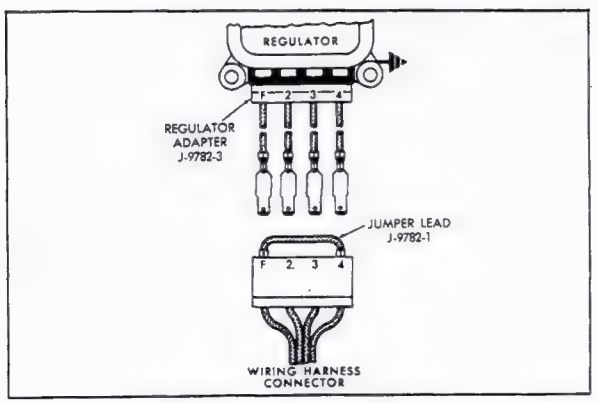


Fig. 6-22 Testing for Opens in Circuit

b. Lamp Glows When Ignition Switch Is "OFF"

1. Unplug connector at rear of generator; if lamp goes out, generator has a shorted diode.

2. If lamp does not go out, make normal connections at generator and remove wiring connector from regulator.

3. If lamp still does not go out, look for a short between #4 lead and #3 lead (or any other lead with battery voltage).

4. If lamp does go out, connect a voltmeter between #2 harness terminal and ground. Any voltage reading indicates that #2 regulator lead is shorted to #3 lead (or another lead with battery voltage). No voltage reading indicates a relay that is mechanically stuck closed.

c. Lamp Glows With Engine Operating At Idle Speed

The possible causes of this condition are covered in Note 33 steps 1, 3, 4, 5 and 6.

NOTE: If defect has been found and corrected at this point, no further checks are necessary.

33. Testing Undercharged Battery Condition

This condition, as evidenced by slow cranking, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally.

1. Check generator drive belt for frayed, worn or loose condition. Adjust belt as outlined in Note 11.

2. If a battery defect is suspected, check as described in Notes 14 and 16.

3. Inspect all connections to be sure they are clean and tight, including the slip connectors at the generator, regulator and firewall. Make sure that the regulator is properly grounded. Inspect the wiring harness for grounds. Clean the battery posts and cable clamps to eliminate resistance. Check with ignition switch on as follows:

a. With harness connector attached to regulator, slide test prod into regulator No. 3 terminal, and connect voltmeter from test prod to ground.

b. If reading is zero, circuit is open between this terminal and battery.

c. Connect voltmeter from generator "F" terminal to ground.

d. If a voltage reading is obtained, proceed to Step 4.

e. If reading is zero, connect voltmeter from regulator "F" terminal to ground.

f. If reading is obtained, "F" terminal lead is open.

g. If reading is zero, connect voltmeter from regulator No. 4 terminal to ground.

h. If reading is obtained, replace regulator or adjust regulator voltage setting.

i. If reading is zero, circuit is open because regulator No. 4 terminal and Ignition Switch.

4. Connect voltmeter from regulator No. 4 terminal to ground. Turn Ignition Switch to "ACC" position. If reading is zero, resistor connected to "ACC" terminal is open.

5. If the indicator lamp operates normally, checks need not be made on the field relay; go to Note 34. However, if the indicator lamp fails to go out with the generator in operation, check the field relay as follows:

a. Connect a voltmeter from regulator No. 2 terminal to ground.

b. Operate engine slightly above idle speed.

c. If voltmeter reads 5 volts or above and the indicator lamp fails to go out, replace regulator.

d. If reading is below 5 volts, connect voltmeter from generator "R" terminal to ground.

e. If reading now is 5 volts or above, lead between generator "R" terminal and regulator No. 2 terminal is defective.

f. If reading is still below 5 volts, proceed to Note 34.

34. Testing Overcharged Battery Condition

An overcharged battery, as evidenced by excessive water usage, can be caused by:

1. Defective Battery: If a defective battery is suspected, check as described in Notes 14 and 16.

2. Poor Circuit Connections: Inspect all connections to make sure they are clean and tight, particularly the circuit between the battery and regulator No. 3 terminal, and the regulator ground.

3. High Voltage Regulator Setting: If no circuit defects are found, yet the battery remains overcharged, proceed to Note 41 - "Adjusting Voltage Regulator Setting."

GENERATOR TESTS AND ADJUSTMENTS

35. Generator Output Test (Fig. 6-23)

1. Disconnect positive battery cable.

2. Install knife blade switch between battery positive post and battery cable terminal.

3. Connect VAT-20 as follows:

a. Set ground polarity switch to negative position.

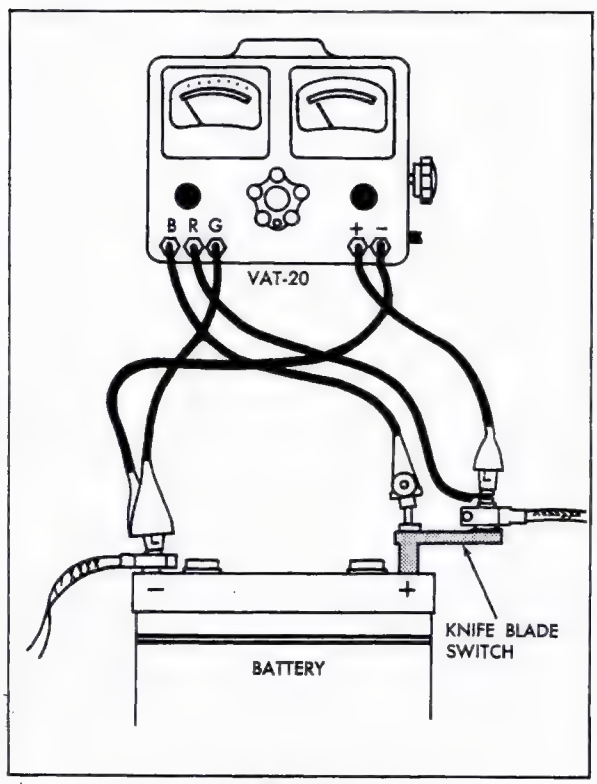


Fig. 6-23 Charging Circuit Test

b. Set load control to direct position.

c. Connect BAT lead of ammeter to knife blade switch terminal stud and connect REG lead to positive battery cable on the knife blade switch, Fig. 6-23.

d. Connect ammeter GRD terminal to negative battery terminal, Fig. 6-23.

4. Close knife blade switch and start engine.

5. Turn off all accessories and close car doors.

6. Open knife blade switch and raise engine speed to approximately 2000 RPM.

7. Adjust load control for highest ammeter reading.

8. Reading should be within 10 amps of rated output of generator.

NOTE: High underhood temperatures may cause amperage reading to be slightly lower than rated.

9. If generator output is within specification proceed to Note 39.

10. If output is low, remove the wiring connector from the back of the generator and install jumper wire J-21053 from "BAT" terminal to "F" terminal.

11. Repeat steps 6 and 7. If output is still low, generator is faulty and must be repaired.

12. If output is within specifications with J-21053 installed, defect is in wiring harness or in regulator. Inspect all wiring connections before proceeding to Note 39.

36. Generator Removal and Installation

a. Removal

1. Raise hood.

2. Disconnect negative battery cable.

3. Disconnect A.I.R. hose at check valve and remove heater hose clip from adjusting link.

4. Remove protective cap from generator positive terminal.
5. Disconnect wires from generator positive terminal.
6. Disconnect double connector from rear of generator.
7. Disconnect black wire from generator ground terminal.
8. Remove screw from generator adjusting link.
9. Loosen lower generator mounting screw and remove generator drive belt.
10. Remove lower generator mounting screw, spacer and washer.
11. Raise adjusting link and remove generator.

b. Installation

1. Position generator against lower mounting bracket and loosely install lower mounting screw, washer and spacer.
2. Swing adjusting link down to generator.
3. Loosely install adjusting link screw.
4. Install generator drive belt on pulley and adjust belt tension as described in Note 11b.
5. Install black wire on generator ground terminal.
6. Connect double connector to back of generator.
7. Connect wires to positive generator terminal.
8. Position protective cap on generator positive terminal.
9. Connect A.I.R. hose to check valve and install heater hose clip on adjusting link.
10. Connect negative battery cable.

37. Generator Disassembly and Assembly

a. Disassembly

1. Remove four through bolts securing drive end frame to slip ring end frame Fig. 6-24.
2. Separate drive end frame, with rotor, from slip ring end frame. Be sure that stator frame stays with slip ring end frame.

CAUTION: Brushes should be cleaned as soon as possible to prevent grease from soaking into brushes.

3. Remove brush springs, which will now be loose.
4. Cover roller bearing in slip ring end frame with a piece of tape to prevent entry of dirt or other foreign material.
5. Insert a 5/16 inch Allen wrench into hex head hole in pulley end of rotor shaft and loosen pulley retainer nut.
6. Remove pulley retainer nut, washer, pulley, fan and small outer collar from rotor shaft.
7. Separate drive end frame from rotor shaft and remove large inner collar.
8. Remove three nuts and lockwashers that hold diode and stator leads to heat sink, disconnect leads and separate stator from slip ring end frame, Fig. 6-25.
9. Remove two screws and flat washers that hold brush holder assembly to slip ring end frame and remove brush holder assembly from end frame.
10. The heat sink should not be removed unless visual inspection indicates need for replacement. Refer to Note 38.

b. Assembly

1. Install brush holder assembly on slip ring end frame and secure with two screws and flat washers. Tighten screws to 12 inch-pounds.
2. Install stator into slip ring end frame with

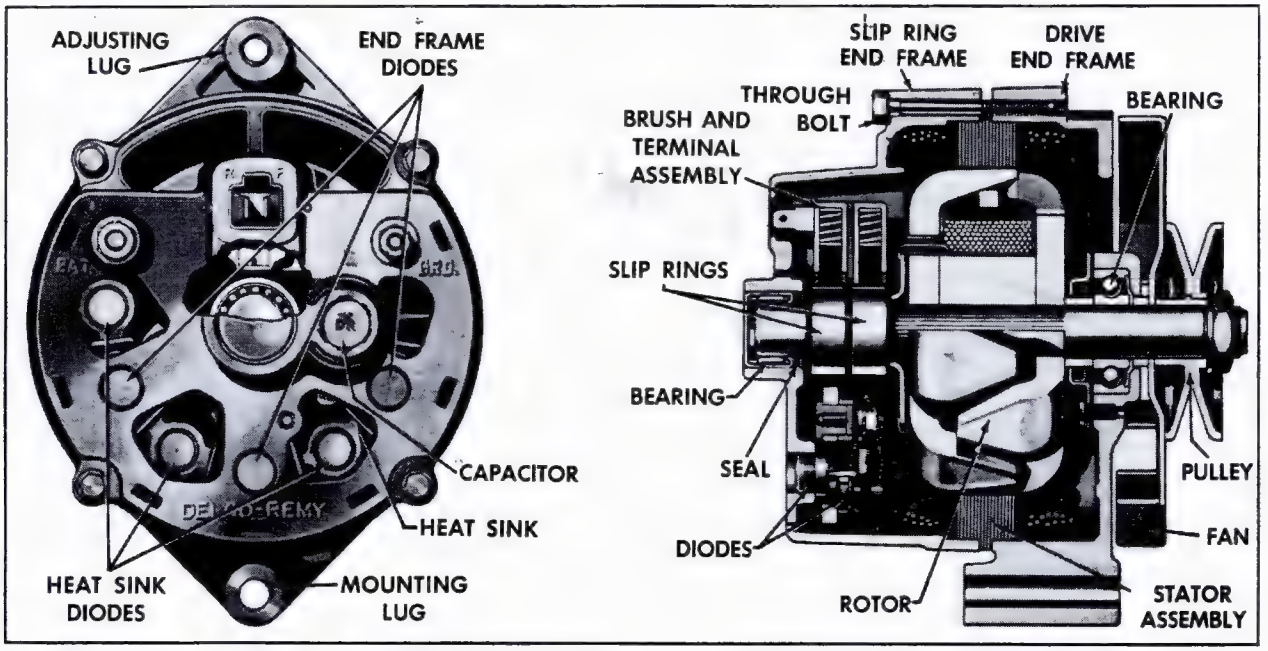


Fig. 6-24 Generator Cut-Away View

three stator leads projecting near connecting terminals.

3. Connect end frame diode leads, heat sink diode leads, and stator leads to their respective terminals, and install retaining nuts and lockwashers.

4. Clean brushes with soft dry cloth to remove any traces of lubricant.

5. Install brush springs and brushes into brush holder and insert a straight wire or pin through hole in end frame and holes in bottom of brush holder. This will hold brushes until rotor is assembled into end frame.

6. Install large inner collar over rotor shaft.

7. Install drive end frame over rotor shaft.

8. Install small outer collar, fan, and pulley over rotor shaft with hub of pulley facing downward, and secure with lockwasher and nut.

9. Insert a 5/16 inch Allen wrench into hex head hole in end of rotor shaft and tighten nut to 55 foot-pounds.

10. Clean slip rings with a soft dry cloth to remove any trace of lubricant.

11. Position the two end frames in relation to each other as shown in Fig. 6-24. Adjusting lug should be directly above "R" and "F" terminals.

12. Install rotor, complete with drive end frame, into slip ring end frame, and retain with four through-bolts.

13. Remove wire or pin projecting through rear of slip ring end frame, allowing brushes to seat on slip rings.

38. Generator Components, Inspection, Testing and Replacement (All Except Commercial Chassis With Optional Generator)

a. Brush Holder Assembly

1. Inspect brush springs for any evidence of damage or corrosion.

2. Inspect brushes for signs of wear and brush pigtails for signs of fraying.

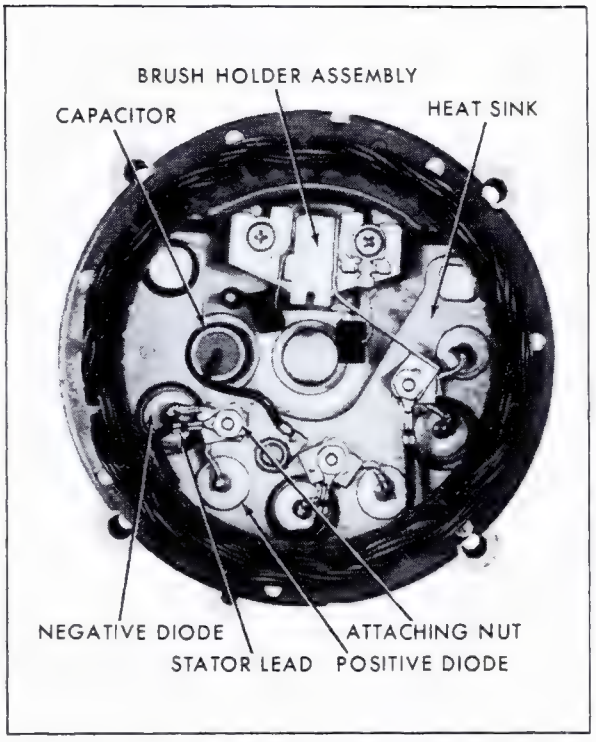


Fig. 6-25 Slip Ring End Frame

3. Inspect brush holder for signs of cracks.

NOTE: The brush holder assembly, including brushes, is serviced as an assembly.

b. Heat Sink

1. Inspect heat sink for signs of cracks.

2. If necessary, replace heat sink by removing two terminal bolts and capacitor lead retaining screw. Carefully note arrangement of parts so that BAT and GRD terminals are replaced in the same order, Fig. 6-26.

c. Diodes

1. Make sure that stator is disconnected and

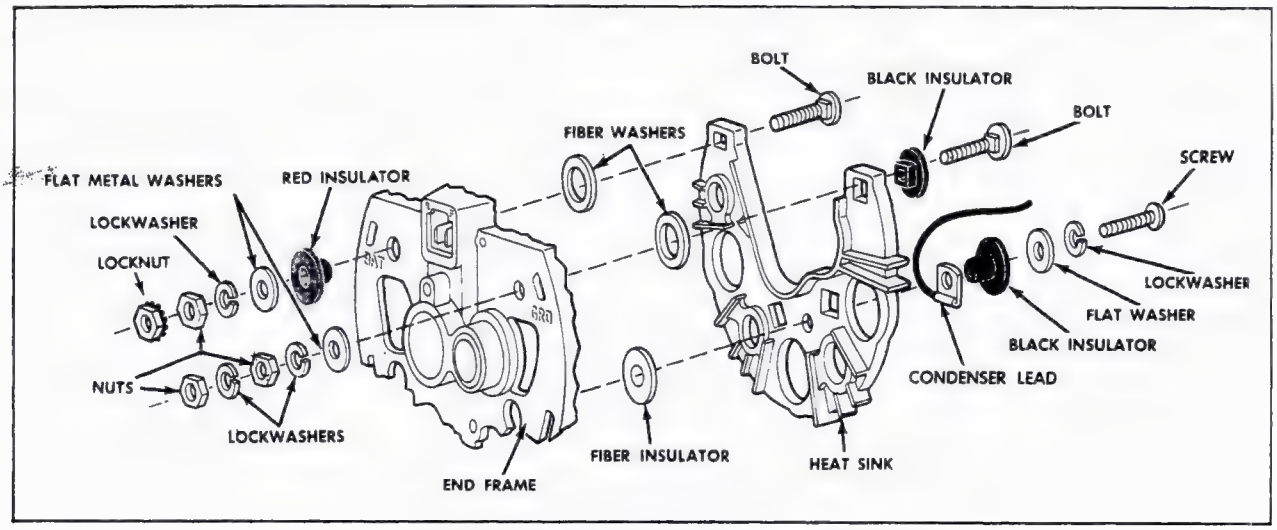


Fig. 6-26 Heat Sink Disassembled

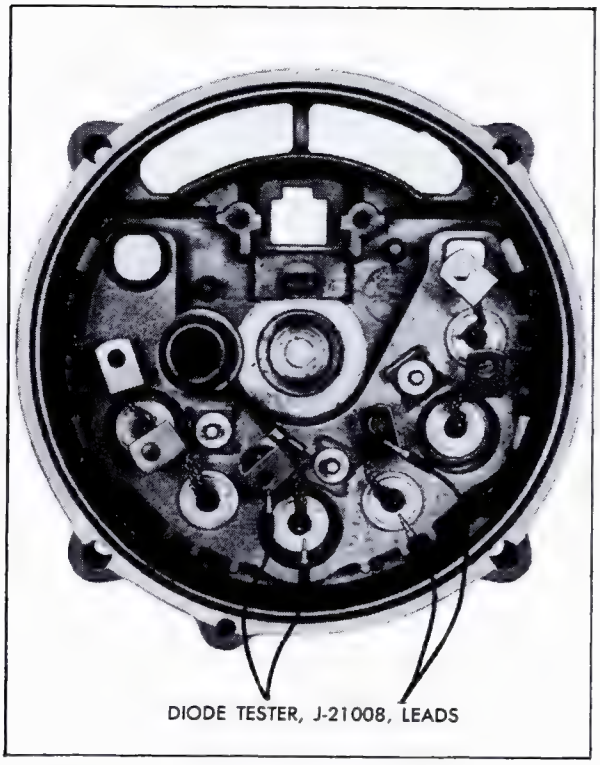


Fig. 6-27 Diode Checking

that each diode lead is disconnected.

2. Connect Test Light, J-21008, leads across each diode, first in one direction and then in the other, Fig. 6-27.

NOTE: When performing these tests, use only Test Light, J-21008.

3. If lamp lights in both directions, or fails to light in either direction, diode is defective. When checking a good diode, lamp will light in only one direction.

4. If necessary to replace diode, support inside of end frame or heat sink with Diode Support, J-9717-2, and press out diode with Diode Remover, J-9717-1, and a vise, Fig. 6-28.

CAUTION: Do not remove diode by striking with a hammer as shock may damage other diodes.

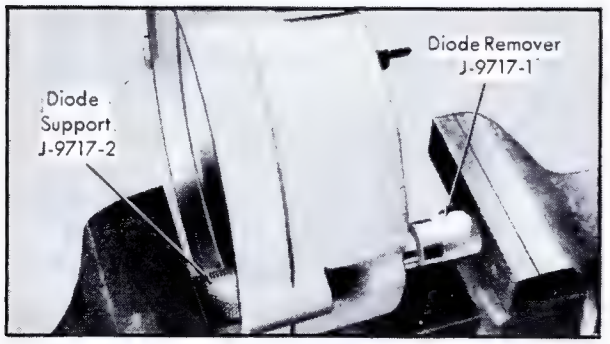


Fig. 6-28 Diode Removal

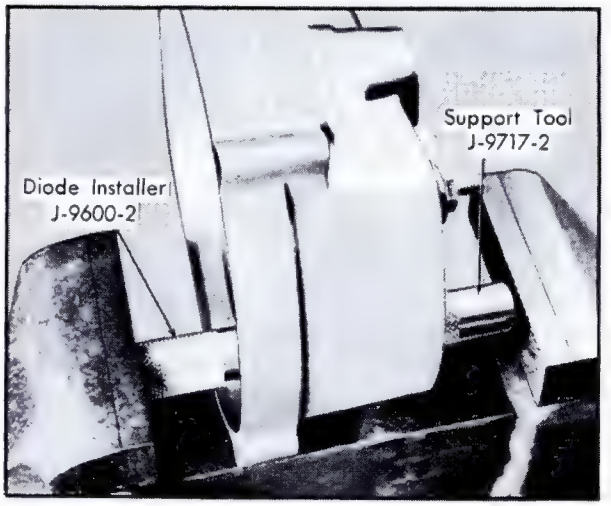


Fig. 6-29 Diode Installation

5. Support outside of end frame or heat sink around diode hole with Diode Support, J-9717-2, and press new diode into position with Diode Installer, J-9600-2, and a vise, Fig. 6-29.

6. Test new diode as described in steps 2 and 3.

d. Capacitor

Once a capacitor has been removed, the capacitor case will become slightly deformed and the new capacitor will not fit tightly when installed. A metal retaining ring is installed as part of the end frame during manufacture. Each time a capacitor is removed, the retaining ring becomes a little larger in diameter until it reaches a point where it can no longer hold the capacitor in place. This ring is not serviceable. For this reason, a capacitor should not be replaced unless it has been tested and found defective as shown below.

1. Test capacitor while it is mounted in the slip ring end frame. Correct capacity is .5 microfarad plus or minus .1 microfarad.

2. If necessary to replace capacitor, remove screw securing lead to heat sink and remove lockwasher, flat washer, and black insulator.

3. Press capacitor out from outside of end frame toward inside using Diode Remover, J-9717-1, and a vise.

CAUTION: Do not remove capacitor by striking with a hammer as shock may damage diodes.

4. Press new capacitor in from inside end frame toward outside, using Diode Installer, J-9600-2, and a vise.

5. Reassemble capacitor lead to heat sink carefully noting arrangement of parts, Fig. 6-26 and secure lead to heat sink with attaching screw.

e. Stator

1. Make sure stator leads are disconnected.

2. Check stator windings for grounds or opens, using a 110-Volt Test Lamp, Fig. 6-30.

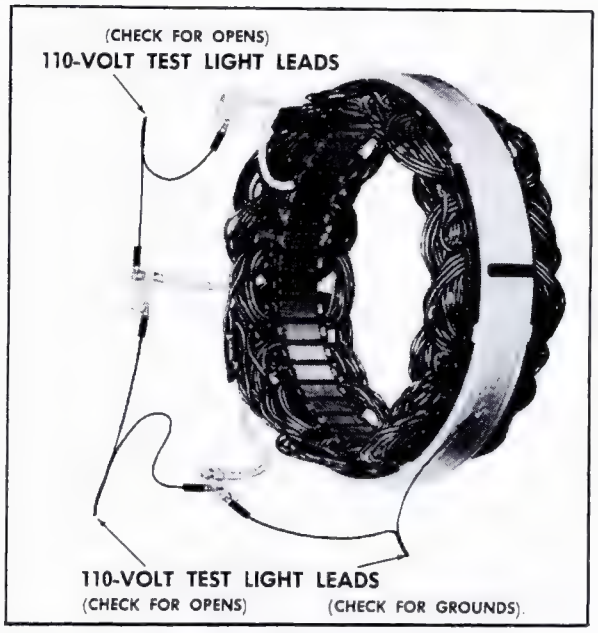


Fig. 6-30 Stator Checking

GROUNDS - If test lamp lights when connected from any lead to stator frame, windings are grounded.

OPENS - If lamp fails to light when successively connected between each pair of stator leads, windings are open.

SHORTS - A short circuit in the stator windings is difficult to find due to the low resistance in the windings. However, if all other electrical checks are normal and generator still fails to supply rated output, it is an indication that the stator windings are probably shorted.

3. If necessary to replace stator, it must be replaced as a unit.

f. Rotor

1. Test rotor for grounds or opens with the aid of 110-Volt Test Lamp, Fig. 6-31.

GROUNDS - Connect test lamp from either slip ring to rotor shaft or rotor poles. If lamp lights, field winding is grounded.

OPENS - Connect the leads of the test lamp to each slip ring. If lamp fails to light, winding is open.

SHORTS - Connect a 12-volt battery and ammeter in series with slip rings and note ammeter reading. If above 2.6 amperes, it is an indication that a shorted winding exists.

2. Inspect slip rings. If they are dirty, they may be cleaned and finished with 400 grain, or finer, polishing cloth. Spin rotor in a lathe to insure that slip rings are cleaned evenly with no flat spots.

3. If necessary, slip rings that are out of round or rough should be turned in a lathe to .001 inch maximum indicator reading. Finish with a 400 grain or finer polishing cloth.

4. If necessary replace rotor as a unit.

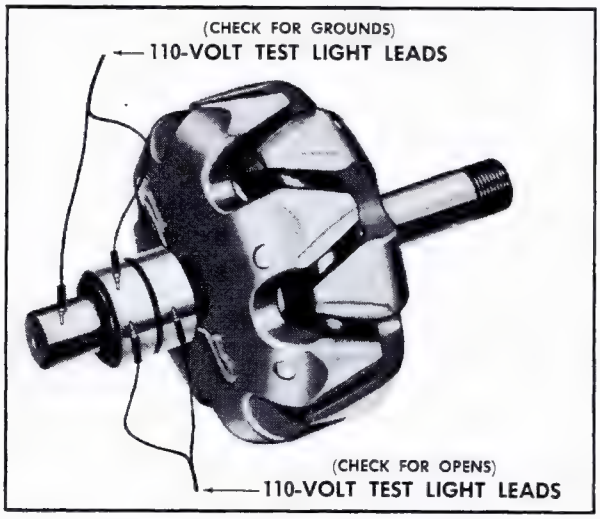


Fig. 6-31 Rotor Checking

g. Bearing—Drive End Frame

1. Check ball bearing in drive end frame for roughness.

2. If necessary to replace bearing, remove three cap screws that hold bearing retainer plate to end frame and remove retainer plate and gasket. Discard gasket.

NOTE: Inspect felt seal in retainer plate. If seal is hardened or excessively worn, discard retainer plate.

3. Support inside of end frame with a hollow cylinder to prevent breakage of end frame.

4. Press bearing and lubricant retainer out of end frame, using a collar or tube that just fits bore of end frame. Press from outside of end frame toward inside. Discard bearing and lubricant retainer.

5. Install new bearing and new lubricant retainer in bore of end frame. Make sure bearing is square in bore of end frame.

6. Press bearing in from inside of end frame toward outside, using a collar or tube that just fits over bearing outer race.

7. Saturate felt seal in retainer plate with engine oil.

8. Install retainer plate using new gasket on end frame and secure with three attaching screws. Tighten screws to 28 inch-pounds. Bend edges of retainer screws over sides of retainer plate to prevent screws from becoming loose.

h. Roller Bearing—Slip Ring End Frame

The roller bearing in the slip ring end frame should be replaced if its lubricant supply is exhausted. No attempt should be made to relubricate and re-use the bearing.

1. If necessary to replace bearing, support inside of end frame with a hollow cylinder to prevent breakage of end frame.

2. Press bearing and seal retainer out of end frame, using a tube or collar that just fits bore of end frame. Press from outside of end frame toward inside. Discard bearing and seal retainer.

3. Install new bearing in bore of end frame

from outside of end frame toward inside. Make sure bearing is square in bore.

4. Support inside of end frame with a hollow cylinder to prevent breakage of end frame.

5. Place a flat plate over bearing and press in until bearing is flush with outside of end frame.

6. Saturate felt seal in new seal retainer with engine oil and install seal retainer in bore of end frame. Press retainer in until it bottoms against bearing.

REGULATOR TESTS AND ADJUSTMENTS

39. Checking and Adjusting Voltage Regulator Setting (All Except Commercial Chassis with Optional Generator)

1. Test generator output as described in Note 35.

2. Leave test instrumentation connected as described in Note 35, Steps 1-3. Remove field jumper wire, J-21053, if used.

3. Set voltage switch to 16 volts position.

4. Connect negative voltmeter lead of VAT-20 to the negative battery terminal and the positive voltmeter lead to the positive battery cable on the knife blade switch, Fig. 6-23.

5. Close knife blade switch and start engine.

6. Turn off all accessories and close car doors.

7. Install temperature gage, J-8529, on cover of regulator and let engine idle for 10 minutes to establish regulator operating temperature.

8. Open knife blade switch and raise engine speed to approximately 2000 RPM.

9. Turn load control knob to the 1/4 ohm position. After voltage reading stabilizes, voltmeter should read within the specification range in the chart.

10. Connect a jumper wire from the base of the regulator unit to a good ground and note voltage reading.

If voltage reading changes when regulator base is temporarily grounded, regulator is poorly grounded and voltage reading is inaccurate. Correct situation before taking final voltage reading.

Regulator Temperature	Voltage	
	Low	High
185°F	13.1	13.9
165°F	13.2	14.0
145°F	13.4	14.2
125°F	13.5	14.4
105°F	13.7	14.6
85°F	13.8	14.8
65°F	13.9	15.0

11. Detach regulator harness connector, remove cover, reconnect harness connector.

12. Turn adjusting screw as shown in Fig. 6-32.

13. For undercharged battery raise setting to upper part of specification range.

14. For overcharged battery lower setting to lower part of specification range.

NOTE: Always make final setting by turning screw clockwise. This insures that spring holder will be against head of screw. If it is necessary to turn screw counterclockwise, turn until screw head is approximately 1/8 inch above adjusting bracket, then pry holder up against screw head and turn clockwise to make setting.

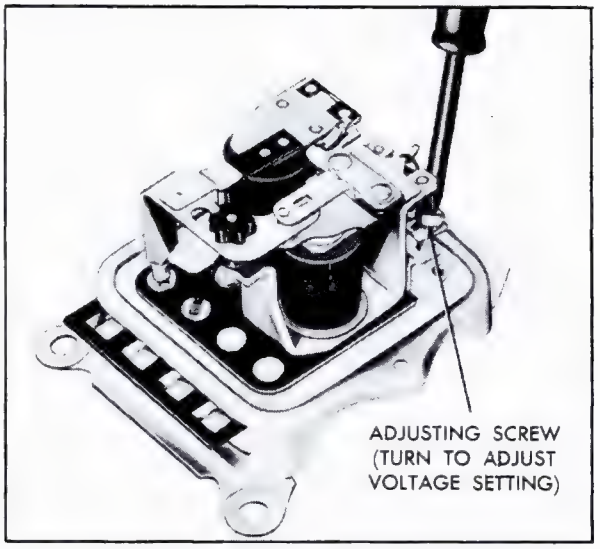


Fig. 6-32 Adjusting Voltage Regulator Setting

15. After making setting, cycle by disconnecting then reconnecting harness connector at regulator.

16. Operate engine at 2000-2200 rpm and note setting. Re-adjust if necessary. Always cycle (Step 15) before reading final voltage setting.

17. This procedure has adjusted the stting while operating on the upper or shorting contacts. Proceed to adjust the setting in the lower or series contacts as follows.

18. Slowly decrease engine speed from the 2000-2200 rpm value and observe voltmeter. When operation changes from upper to lower contacts, voltmeter reading should suddenly decrease between .1 and .3 tenths of a volt.

19. To decrease the difference in voltage between upper and lower contact operation, turn the nylon nut, Fig. 6-32 clockwise a slight amount. To increase the difference, turn nylon nut counterclockwise. If this adjustment is made, the voltage setting must be re-checked as covered in Steps 12 through 18.

CAUTION: Do not attempt to check regulator except when mounted on car and properly grounded. Operation without ground will destroy regulator.

20. If voltage operation is erratic, and if the

regulator cannot be adjusted to a steady value, replace the regulator.

NOTE: Always remove harness connector at regulator when removing or replacing cover to avoid accidental grounds and consequent damage to regulator.

CHARGING SYSTEM—COMMERCIAL CHASSIS WITH HEAVY DUTY GENERATOR ONLY

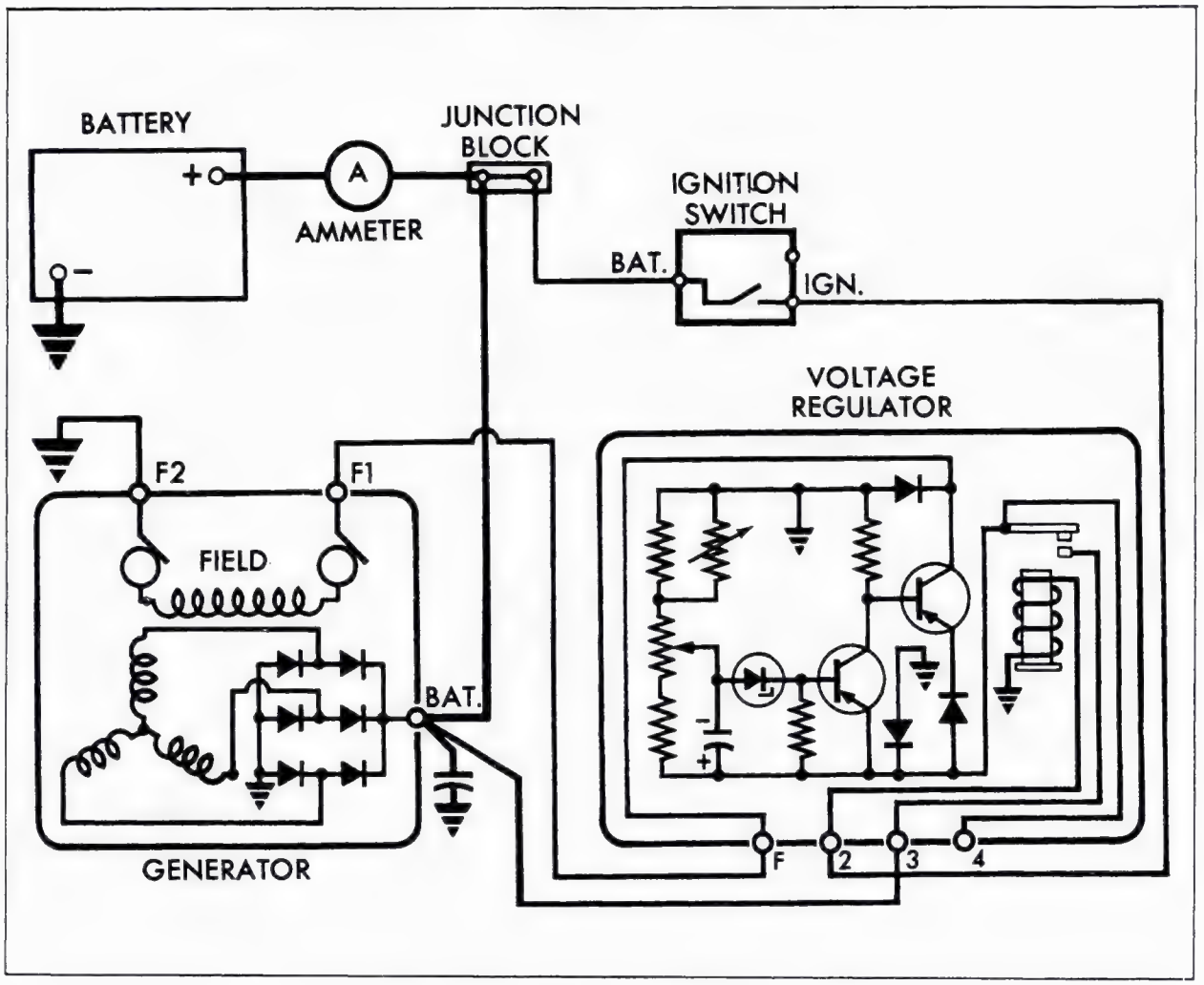


Fig. 6-33 Basic Transistor Charging Circuit

40. Analyzing Charging System Troubles

The checking procedures outlined in Note 41 assume that some malfunction has occurred in the charging system and that it is necessary to determine what is causing the malfunction. Since the charging system consists of our basic units--the regulator, the generator, the wiring and the battery--it is important to determine which unit is causing the trouble in order that the proper unit may be repaired or replaced.

The transistor regulator has an adjusment provision which may be used to tailor the voltage limit for unusual operating conditions that result in overcharged or undercharged batteries. An adjustment of the regulator may be sufficient to correct the under or overcharged battery condition. In the event that the regulator is found to be faulty, it should be replaced.

If the generator is the cause of the malfunction, it may either be replaced or repaired as described in Notes 46 and 47.

Any wiring deficiencies must be repaired or the faulty wiring should be replaced.

The battery should be checked to determine its condition in accordance with Notes 14 and 16 and replacement may be indicated.

The troubleshooting procedures for the regulator are described in Note 43.

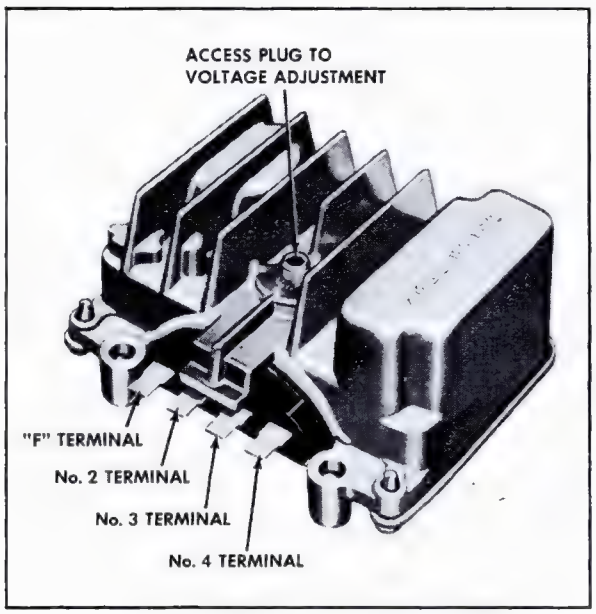


Fig. 6-34 Transistor Regulator

41. Testing Ammeter Circuit

a. The Ammeter Indicates A Discharge With All Accessories "Off" and the Ignition Switch In the "Off" Position.

1. There is the possibility that a stuck relay could cause this condition which would lead to a discharged battery. To check, remove connector body from regulator terminals.

a. If the ammeter continues to show a discharge, the problem is elsewhere on the vehicle and an unwanted ground exists.

b. If the ammeter no longer shows a discharge, either a stuck relay exists or there is an unwanted short in the wiring. To check wiring, connect a voltmeter between the regulator No. 2 terminal of the connector body and ground. (Ignition switch must be "off" and connector body is still removed from regulator.) A voltage indication on the meter indicates a short between the wire leading to the No. 2 terminal and a wire containing battery voltage (the wire leading to the regulator No. 3 terminal could be suspected). No voltage indication on the meter indicates a stuck relay and the regulator should be replaced.

b. The Ammeter Indicates A Discharge With All Accessories "Off" and the Engine In Operation At Idle Speed.

1. There is the possibility that an open relay or an open regulator field circuit exists. To check, connect a jumper between the regulator base and a good ground. If the ammeter now shows a slight charge, the regulator does not have a good ground. If the grounding of the base makes no difference on the ammeter indication, proceed with step 2.

2. Connect a voltmeter between regulator No. 2 terminal and ground. No reading on the meter indicates an open between the regulator No. 2 terminal and the battery. Wiring and switch should be checked to locate the open circuit. If battery voltage is noted at the No. 2 terminal, proceed to step 3.

3. Connect voltmeter between the regulator "F" terminal and ground. If no reading is noted, the regulator should be replaced. If 10 volts or more are available, place voltmeter between the generator "F-1" terminal and ground. If no reading is noted, the lead from the generator "F-1" terminal to the regulator "F" terminal is open and should be replaced. If the reading is approximately 10 volts, or more, proceed to Note 42.

4. If ammeter operation seems proper, but an over or undercharged battery exists, proceed to Note 42.

42. Generator Output Test

To check for an undercharged battery condition, as evidenced by slow cranking, follow the procedure beginning with Step 1. For an overcharged battery, as evidenced by excessive battery water usage, begin with Step 9.

1. Connect an ammeter in the circuit at the generator "BAT" terminal, Fig. 6-35.

CAUTION: A high reading ammeter must be used due to 130 amp capacity of generator.

2. Connect a voltmeter from "BAT" terminal of generator to ground, Fig. 6-35.

3. Disconnect normal lead to "F2" terminal and connect a jumper wire between "F2" terminal and ground, Fig. 6-34.

4. Disconnect normal lead to "F1" terminal and connect a jumper lead from the generator "F1" terminal to the generator "BAT" terminal.

5. Start engine, turn on high beam headlights, place Automatic Climate Control selector lever in HI position and insert 1/4 ohm resistor.

6. Slowly increase engine speed to 2,500 RPM and note ammeter reading.

NOTE: As engine speed is increased, vary load control so that voltage does NOT exceed 16 volts.

7. If output is within 15 amperes of rated output, generator is in satisfactory condition.

NOTE: Checking generator output in this manner may allow generator to show 5 - 10% more amperage than shown in specifications. Be sure test ammeter has at least 150 amps capacity.

a. If current output is lower than that specified, repair the generator as described in Note 47.

b. If generator failure was caused by a defective stator or diodes, the repaired generator may be placed on the car and no further checks are needed on the system.

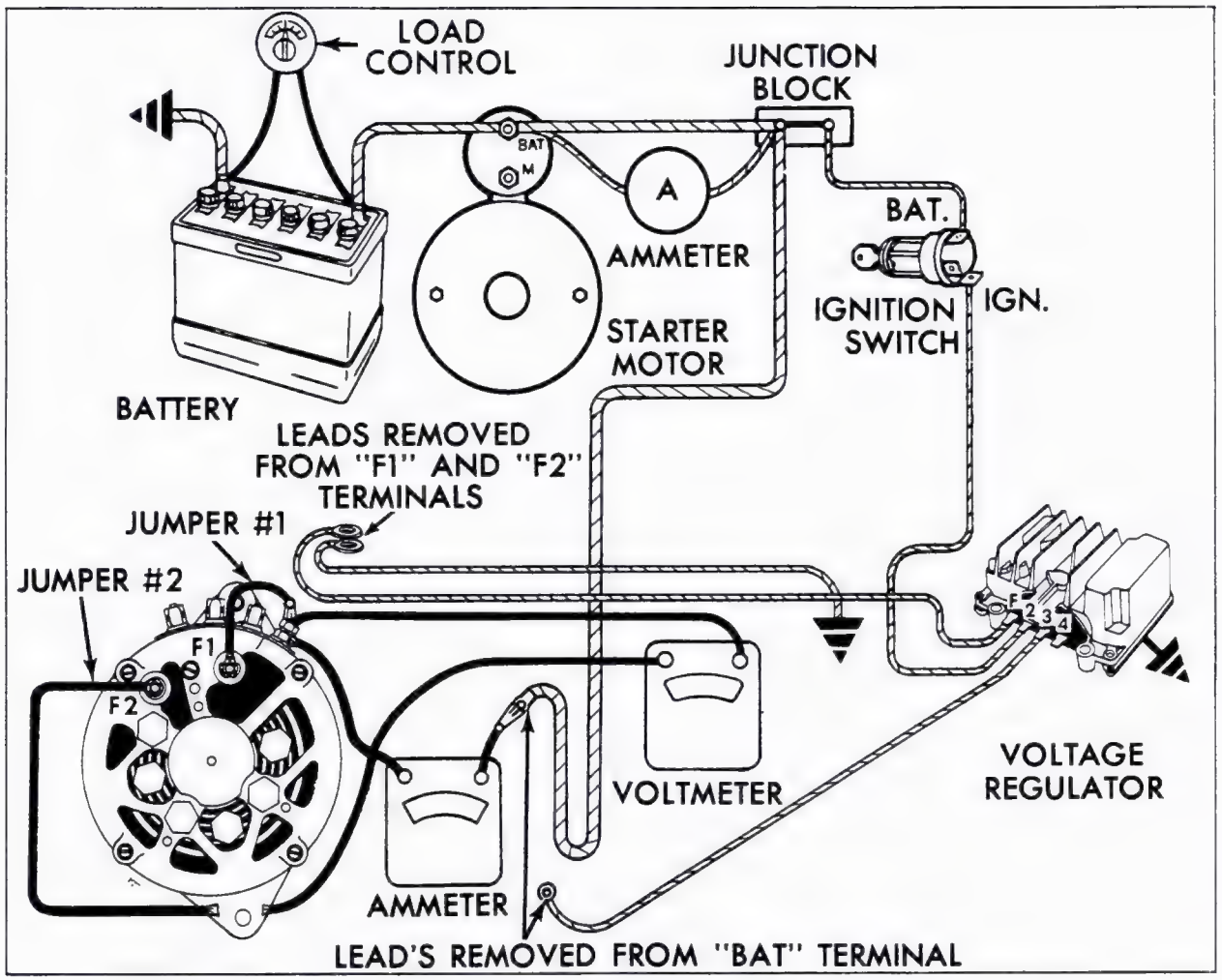


Fig. 6-35 Generator Output Test

c. If the generator failure was caused by a defective field winding, the repaired generator may be placed on the car, and the following checks, beginning with Step 8 must be made to locate possible damage to the regulator.

d. If the current output meets the specifications, the generator is okay -- proceed with Step 8.

8. Remove jumper leads, ammeter, and voltmeter from generator and proceed with Step 9.

9. Connect a jumper between the No. 3 and No. 2 terminals of the regulator, Fig. 6-36. Slide prods into the connector body to make connections. Do not leave jumper lead in this position longer than 5 minutes.

10. Connect voltmeter positive lead to battery positive post and voltmeter negative lead to regulator No. 3 terminal. Turn the ignition switch "on", Part 1 of Fig. 6-36. Read the voltage drop.

11. Connect voltmeter positive lead to regulator mounting bolt, and voltmeter negative lead to battery negative post with jumper lead in position, Part 2, Fig. 6-36. Record the voltage drop.

Add the voltage from Step 10 voltage from Step 11 to get the Total Voltage Drop.

a. If total voltage drop is greater than .25 volt, check system wiring and ground circuits for high resistance. Check regulator for proper ground.

b. If total voltage is less than .25 volt, remove jumper lead between No. 2 and No. 3 terminals, if present, and proceed as follows:

12. Operate the engine at approximately 1500 RPM for 15 minutes with lower beam headlights "on". Thermometer, Tool J-8529, should be placed on the regulator. With engine running, record voltage reading with voltmeter connected from the regulator No. 3 terminal to ground, Fig. 6-37.

NOTE: If actual voltage is not within the specified range, remove access plug from regulator cover and note the position of the plastic screw slot beneath the plug. The slot will be lined up with one of the divisions or lines cast on the regulator cover. For each division the slot has been moved clockwise from the middle

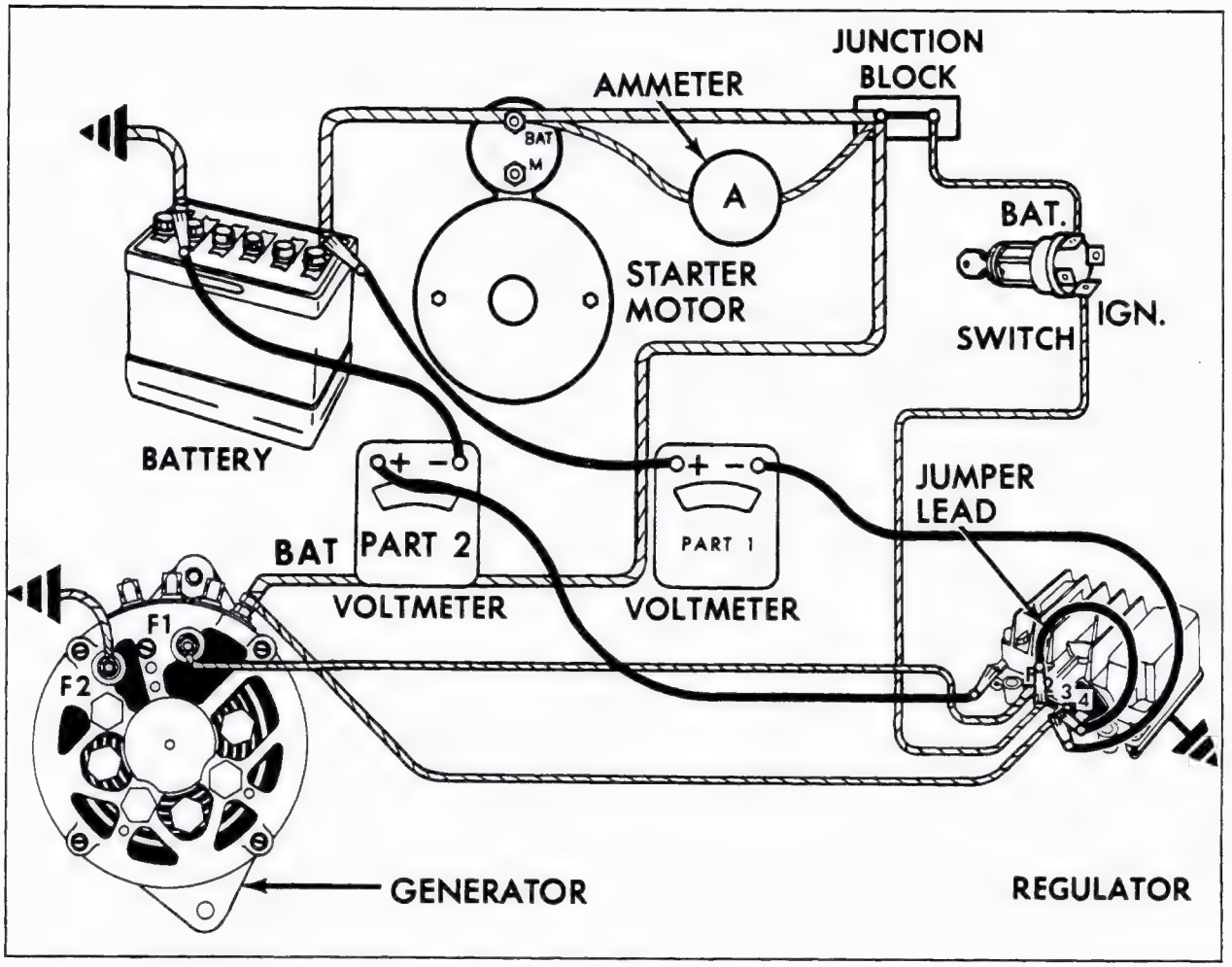


Fig. 6-36 Testing Wiring for High Resistance

position ("O" position) or toward the "+" cast on the cover, add 0.3 volt to the above specified range for the proper specified voltage limits. For each division the slot has been moved counterclockwise from the middle ("O" position), toward the "-" on the cover, subtract 0.3 volt from the specified range for the proper voltage limits. As an example, assume that the slot is lined up with the second line from the "O" nearest the "+" mark. This position would require adding of 0.6 volt to the voltage shown in the specification table. The limits at 125° would become 14.2 to 14.9 volts instead of the 13.6 to 14.3 volts specified for the middle or "O" position.

If the actual regulating voltage as checked is not within the voltage range specified for the ambient temperature, the regulator should be replaced.

13. If the actual regulating voltage as checked in Step 12 is within the voltage range specified for the ambient temperature, the charging system operation is satisfactory. However, the voltage setting of the regulator needs to be changed to meet battery requirements for the type of driving being done. To adjust the voltage setting properly, refer to Note 44.

Read voltage setting and compare with specifications below. Ambient temperature is measured on Thermometer, J-8529.

43. Checking Voltage Setting

The desired voltage regulator setting is one which keeps the battery in a satisfactory state of charge (3/4 charge or more) without causing excessive battery overcharge (as evidenced by excessive battery water usage).

The "normal" setting (values shown in the "Voltage Table") usually will be satisfactory for the vehicle operated in average type service conditions. However, if operating service conditions are above or below average, the voltage regulator setting must be adjusted or tailored to adapt it to the battery and service conditions.

Either of two conditions may persistently exist which indicate the need for adjusting the regulator setting: (1) battery is being overcharged, (2)

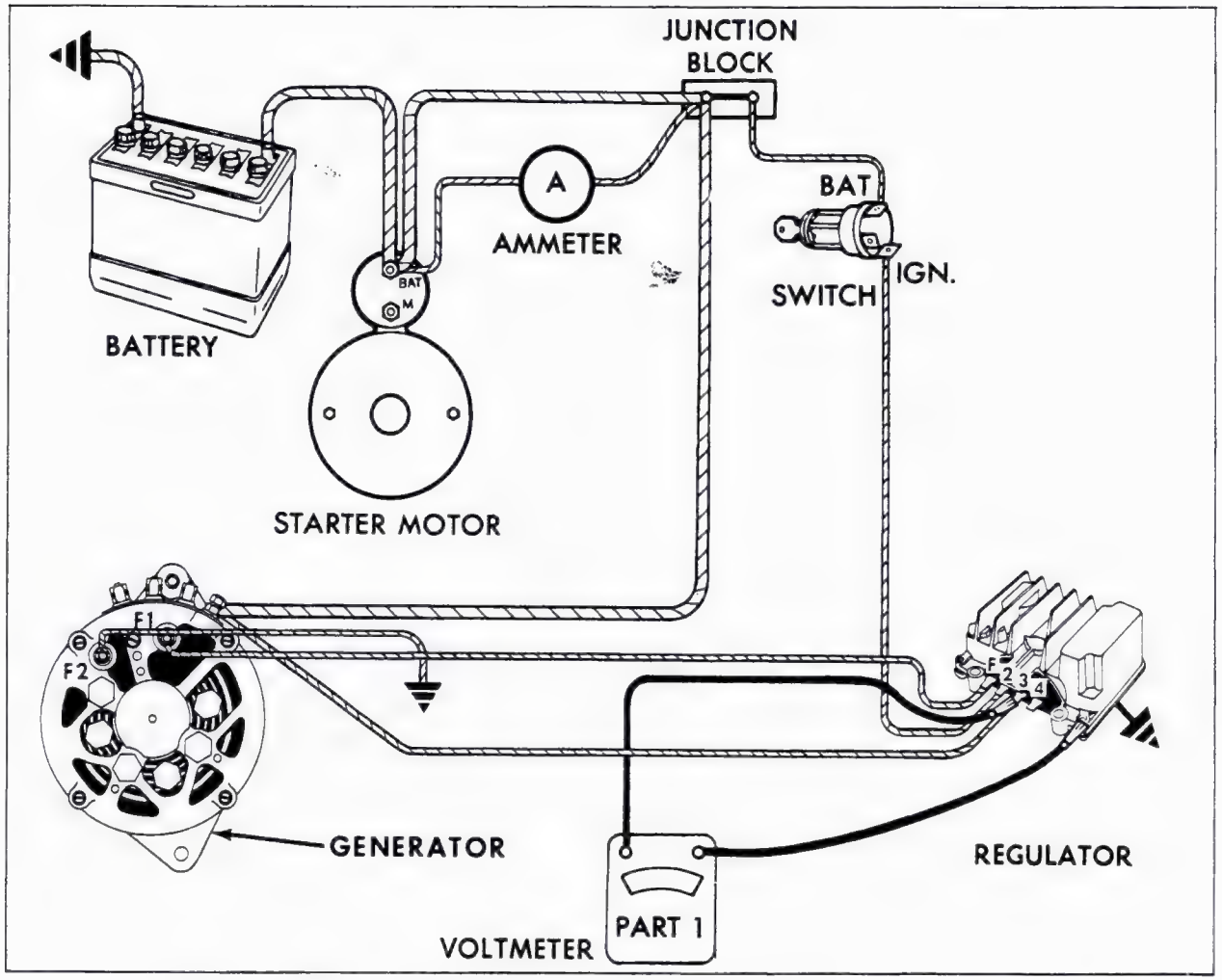


Fig. 6-37 Checking Voltage Regulator Setting

VOLTAGE TABLE

Ambient Temperature	65°	85°	105°	125°	145°	165°	185°
Normal Voltage Setting	14.1 to 14.9	13.9 to 14.7	13.7 to 14.5	13.6 to 14.3	13.4 to 14.2	13.2 to 14.0	13.1 to 13.8

battery remains undercharged. Corrections should be made as follows:

1. If the battery uses too much water at the "normal" setting, reduce the voltage setting approximately 0.3 volt and check for decreased battery water usage over a reasonable service period. If necessary, repeat this process until the battery remains charged with a minimum use of water.

2. If the battery is consistently undercharged (evidenced by inability to crank the engine) at the "normal" setting, increase the voltage setting 0.3 volt and check for improved condition over a reasonable service period. If necessary, repeat this process until the battery remains charged with a minimum use of water.

44. Adjusting Voltage Regulator Setting (Fig. 6-38)

To adjust the voltage setting of the transistorized regulator, remove the access plug from the regulator. Then for an undercharged battery insert screwdriver into slot and turn clockwise one notch (0.3 volt) to increase the setting. For

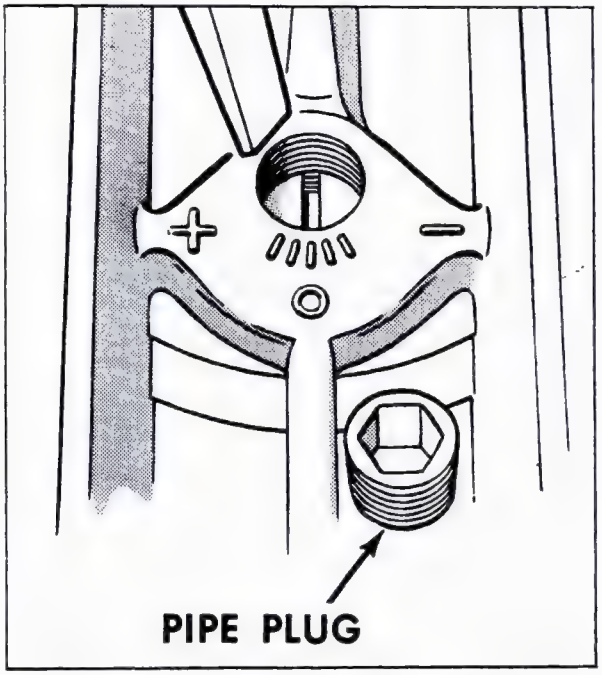


Fig. 6-38 Adjusting Voltage Regulator Setting

an overcharged battery, turn counterclockwise one notch (0.3 volt) to decrease setting. See Fig. 6-38. Check for an improved battery condition over a reasonable service period. If necessary, repeat procedure for a higher or lower setting.

45. Generator—Removal and Installation (Commercial Chassis With Optional Generator Only)

a. Removal (Fig. 6-39)

1. Disconnect battery ground cable at battery.
2. Disconnect wires from "BAT", "GRD", "F1" and "F2" terminals at the generator. Also disconnect any leads from the "AC" terminals.
3. Remove generator link adjusting screw.
4. Remove two nuts and lock washers from mounting bolts at front and rear of generator mounting bracket.
5. Disconnect drive belt from generator pulley.
6. Remove two bolts securing generator to mounting bracket.
7. Remove generator from vehicle, leaving mounting bracket in car.

b. Installation

1. Position generator on mounting bracket and install two bolts through mounting lugs. Install lockwashers and nuts on mounting bolts but do not tighten.
2. Install generator link adjusting screw but do not tighten.
3. Install drive belt on the pulley and adjust belt tension as described in Note 11b.
4. Tighten two mounting bolts to 18 foot-pounds.
5. Connect wires at "BAT", "F1", "F2" terminals, and any wires disconnected from "AC" terminals.
6. Connect battery ground cable at battery.

NOTE: It is not necessary to "polarize" this generator and this procedure should not be attempted.

46. Generator Disassembly and Assembly (Commercial Chassis With Optional Generator Only)

a. Disassembly (Fig. 6-40)

1. Remove four through bolts securing drive end frame to slip ring end frame, Fig. 6-40.
2. Separate drive end frame, with rotor, from slip ring end frame by tapping lightly on mounting lugs with a plastic mallet.

CAUTION: To prevent damage to brushes during this operation, insert a through bolt into the slip ring end frame and lift brushes off slip rings.

NOTE: Brushes should be cleaned as soon as possible to prevent grease from soaking into brushes.

3. Remove stator assembly from heat sink end frame by removing three AC leads from AC terminals and tapping heat sink away from stator.
4. To remove brushes proceed as follows:
a. Remove retaining clip from brush holder pivot and remove both brushes and brush springs.
b. Remove two nuts with lock washers and flat washers from "F1" and "F2" terminals.
c. Remove studs from slip ring end frame and remove brush assemblies.
5. Cover slip ring roller bearing on rotor shaft with a rag and tape securely to prevent collecting dirt or other foreign material.
6. Block pulley-fan assembly and remove pulley retainer nut, washer, pulley-fan assembly, woodruff key and spacer from rotor shaft.
7. Remove rotor assembly by removing four screws holding bearing retainer plate to drive end frame and separate drive end frame from rotor assembly.
8. The heat sink should not be removed unless inspection indicates need for replacement. Refer to Note 47.

b. Assembly

1. Assemble drive end frame on rotor shaft. Install bearing retainer plate and secure with four screws.
2. Install spacer, woodruff key, pulley-fan assembly, washer and retaining nut on rotor shaft. Torque retaining nut to 60 foot-pounds.

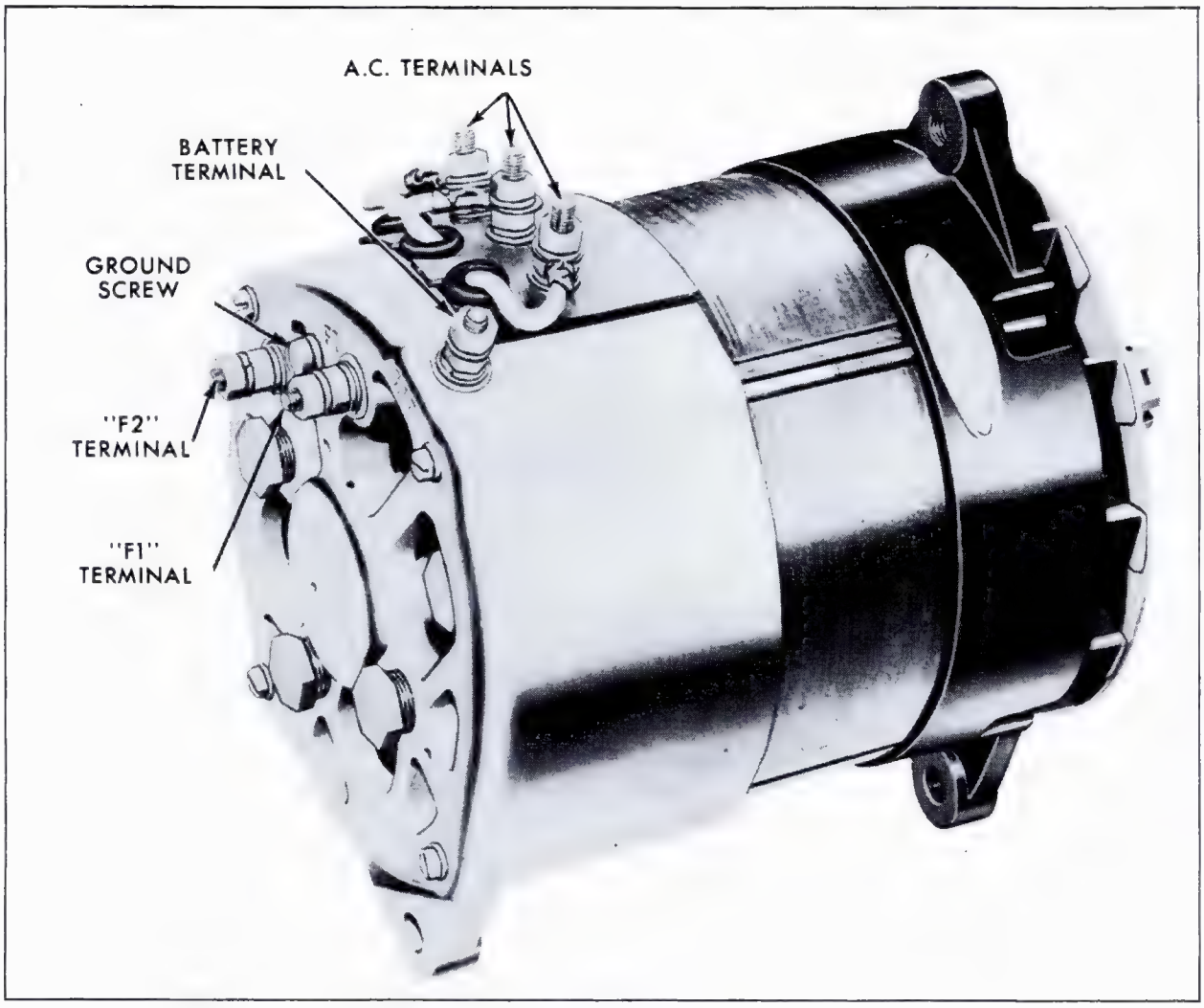


Fig. 6-39 Heavy Duty A.C. Generator

3. Assemble brush assemblies in heat sink as follows:

a. Install brush with lead from "F1" terminal on brush pilot and install lower spring with open end against stop and hooked end against brush assembly.

NOTE: Springs are not identical. The hooked end should be down on the lower spring and up on the upper spring.

b. Install upper spring and install brush with lead from "F2" terminal. Connect spring to brush assembly as described above.

c. Secure brush assemblies with retainer clip.

4. Install stator into slip ring end frame assembly and fasten leads to AC terminals making sure leads are not stretched.

5. Secure drive end frame in a vise with slip ring end of rotor straight up. Lower the heat sink-stator assembly onto the rotor while holding the brushes away from the slip rings with a through-bolt. Secure slip ring end frame to drive end frame with four through-bolts.

47. Generator Components, Inspection, Testing and Replacement (Commercial Chassis With Optional Generator Only)

a. Brush Holder Assembly

1. Inspect brush springs for any evidence of damage or corrosion.

2. Inspect brushes for excessive wear and brush pigtails for signs of fraying, Fig. 6-41.

3. Inspect brush holders for signs of cracks.

NOTE: The brush holder assembly, including brushes, is serviced as an assembly.

b. Heat Sink

1. Inspect heat sink for signs of cracks.

2. If necessary, replace heat sink by removing two terminal bolts and capacitor lead retaining screw. Carefully note arrangement of parts so that BAT and GRD terminals are replaced in the same order.

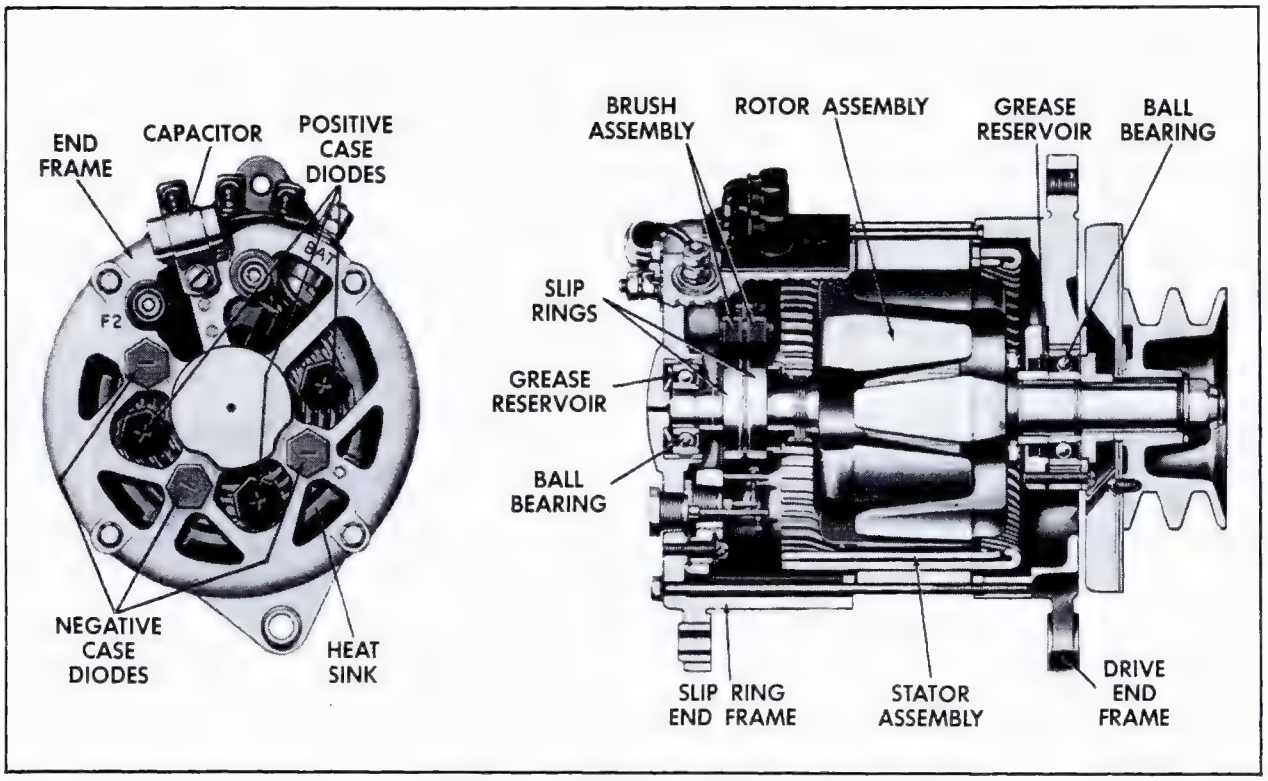


Fig. 6-40 Generator Cut-Away View

To remove heat sink proceed as follows:

a. Perform steps 1 through 4 of generator disassembly, Note 47a.

b. Loosen "BAT" terminal lock nut so that "BAT" terminal stud moves freely.

c. Remove two screws with lock washers and flat washers holding heat sink to end frame.

d. Cut diode leads in three places as shown in Fig. 6-43 and remove heat sink from end frame.

c. Diodes

1. Make sure that stator is disconnected and that each diode lead is disconnected.

2. Connect Test Light, J-21008, leads across each diode, first in one direction and then in the other, Fig. 6-42.

NOTE: When performing these tests, use only Test Light, J-21008 or an ohmmeter.

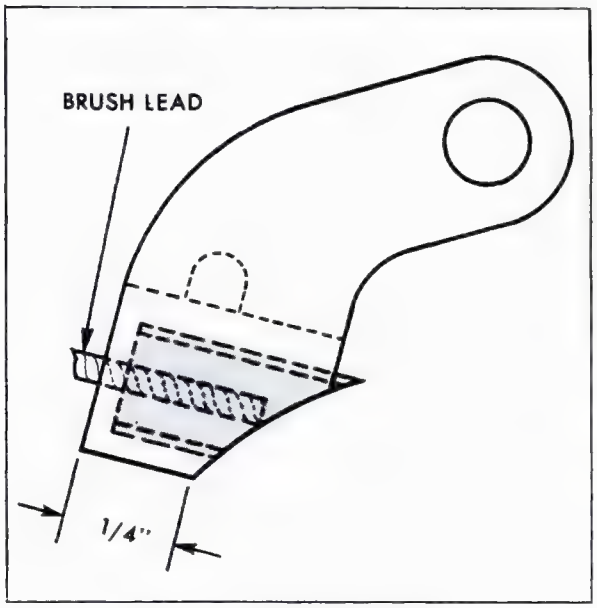


Fig. 6-41 Maximum Brush Wear

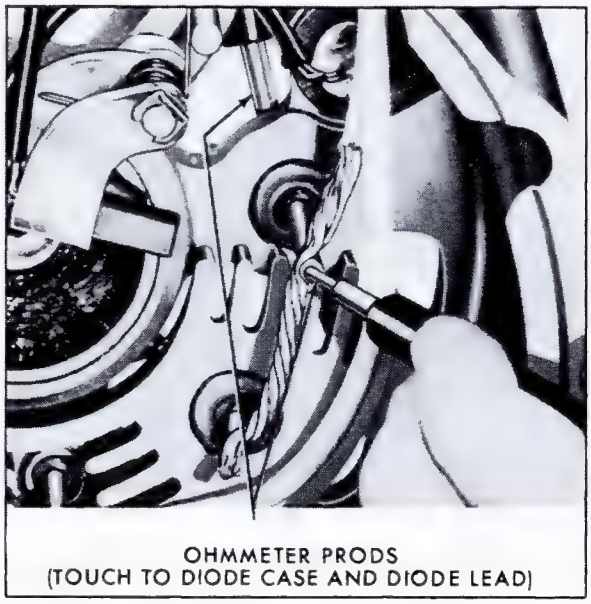


Fig. 6-42 Diode Checking

Diodes may also be checked for defects with an ohmmeter as shown in Fig. 6-42. To check each diode, connect one of the ohmmeter leads to the diode case, and the other ohmmeter lead to the diode lead, and note the ohmmeter reading. Then reverse the ohmmeter lead connections and note the reading. Ohmmeter readings may vary considerably when checking diodes, but if both readings are 300 ohms or less, the diode is defective. Also, if both readings are greater than 300 ohms, the diode is defective. A good diode will give one low and one high reading. When checking each diode, push and pull on the diode lead to catch loose connections, and use on ohmmeter with a scale on which the 300 ohm value can be accurately read.

3. If lamp lights in both directions, or fails to light in either direction, diode is defective. When checking a good diode, lamp will light in only one direction.

4. If it is necessary to replace a diode mounted in the end frame, use diagonal cutters to clip the flexible leads on each side of the diode lead. Clip the flexible leads as close to the diode lead as possible, Fig. 6-43.

5. To permit easy removal of the defective diode, it is recommended that the diode and end frame be heated in an oven to 150°F. or briefly submerged in hot water just below the boiling point.

6. Before installing the new diode, lightly coat the threads with silicone grease or light engine oil. With the diode and outside frame at room temperature, install the diode and torque to 160-190 inch-pounds.

7. Place the single diode lead clip furnished with the replacement diode over the diode lead, and place the ends of the flexible leads into the clip. Crimp the clip tightly over the flexible leads, and liberally solder the leads to the clip, and the clip to the diode lead.

CAUTION: Use only 60% tin, 40% lead solder, or other solder with melting point of 360°F. or above. Do not hold the soldering iron on the leads any longer than necessary, as excessive heat may damage the diode.

8. If it is necessary to replace a diode mounted in the heat sink, it will be necessary to remove the heat sink from the end frame. This is accomplished by clipping with diagonal cutters the flexible lead as close to the defective diode lead as possible. Also clip the flexible leads midway between the other two pairs of diodes, Fig. 6-43. Then remove the "BAT" terminal and heat sink attaching screws, and the long leads from the nylon connector. For easy removal of the defective diode, it is recommended that the diode and heat sink be heated in an oven to 150°F., or briefly submerged in hot water just below the boiling point.

9. Before installing the new diode, lightly coat the threads of the new diode with silicone grease or light engine oil. With the diode and heat sink at room temperature, install the diode and torque to 160-190 inch-pounds. Attach the heat sink to end frame, place the single diode lead clip furnished with the replacement diode onto the diode lead, insert the flexible lead into the clip, crimp securely, and solder the lead to the clip and the clip to the diode lead. Also, use the two connectors to reconnect the flexible leads together. Place the leads into the connectors, crimp securely, and solder.

CAUTION: Use only 60% tin, 40% lead solder, or other solder with melting point of 360°F., or above. Do not hold the soldering iron on the leads any longer than necessary, as excessive heat may damage the diode.

NOTE: Replacement diodes have a long diode lead. If the diode is to be assembled into the heat sink it is necessary to cut off the diode lead to an over-all length of 1-3/8 inches, Fig. 6-44. To cut off the diode lead, hold the diode lead with ordinary pliers or vise grip pliers, and use large diagonal cutters or a hack saw, Fig. 6-42.

CAUTION: Do not grip the diode case when cutting the lead, as this will place stress between the diode case and the diode lead, and will damage the diode internally.

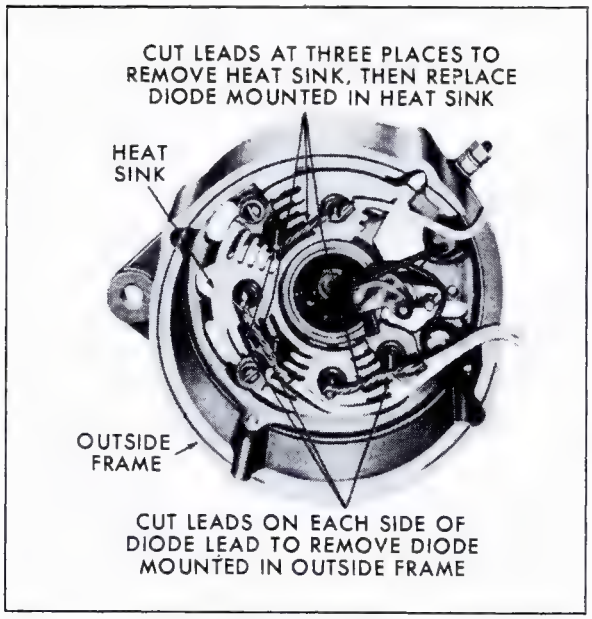


Fig. 6-43 Replacing Defective Diodes

d. Stator

1. Make sure stator leads are disconnected.

2. Check stator windings for grounds or opens, using a 110-Volt Test Lamp, Fig. 6-30.

GROUNDS - If test lamp lights when connected from any lead to stator frame, windings are grounded.

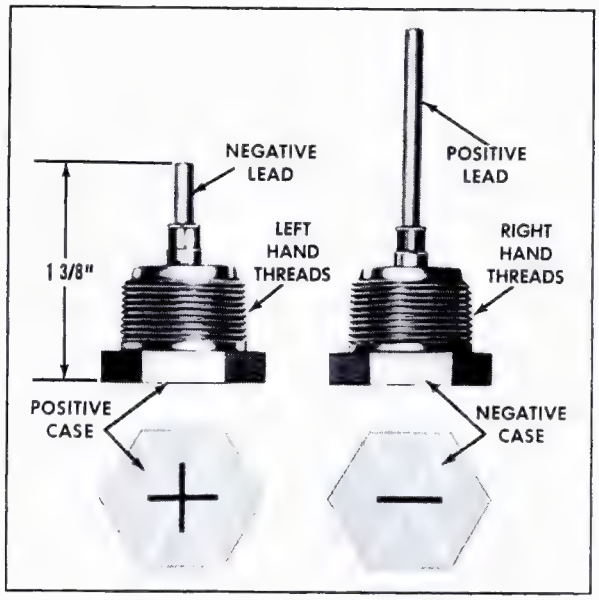


Fig. 6-44 Diode Polarity

OPENS - If lamp fails to light when successively connected between each pair of stator leads, windings are open.

SHORTS - A short circuit in the stator windings is difficult to find due to the low resistance in the windings. However, if all other electrical checks are normal and generator still fails to supply rated output, it is an indication that the stator windings are probably shorted.

3. If necessary to replace stator, it must be replaced as a unit.

e. Rotor

1. Test rotor for grounds or opens with the aid of 110-Volt Test Lamp, Fig. 6-31.

GROUNDS - Connect test lamp from either slip ring to rotor shaft or rotor poles. If lamp lights, field winding is grounded.

OPENS - Connect the leads of the test lamp to each slip ring. If lamp fails to light, winding is open.

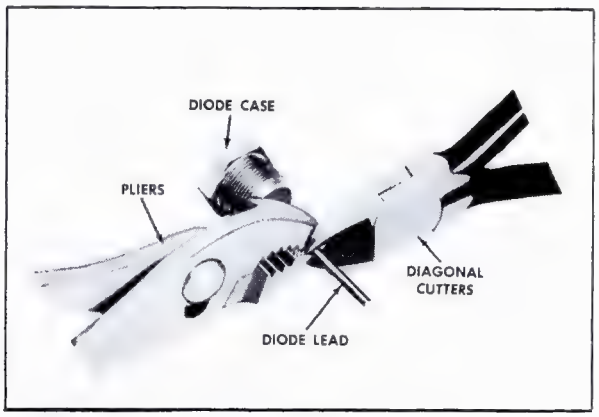


Fig. 6-45 Cutting Diode Lead

SHORTS - Connect a 12-volt battery and ammeter in series with slip rings and note ammeter reading. If above 2.6 amperes, it is an indication that a shorted winding exists.

2. If rotor is defective, replace as a unit.

3. Inspect slip rings. If they are dirty, they may be cleaned and finished with 400 grain, or finer, polishing cloth. Spin rotor in a lathe to insure that slip rings are cleaned evenly with no flat spots.

4. If necessary, slip rings that are out of round or rough should be turned in a lathe to .002 inch maximum indicator reading. Finish with a 400 grain or finer polishing cloth.

5. Slip rings which must be replaced can be removed from the shaft with a gear puller after the leads have been unsoldered. The new assembly should be pressed on with a sleeve which just fits over the shaft; this will apply all the pressure to the inner slip ring collar and prevent damage to the outer slip rings. Only pure tin solder should be used when reconnecting the field leads. Make sure the soldered connections are secure. New slip rings must be turned in a lathe to a smooth finish with .002 inch maximum indicator reading. Finish with 400 grain or finer polishing cloth.

f. Brush Replacement

The brushes may be allowed to wear until part of the holder itself is actually worn away as shown in Fig. 6-41. This will not damage the slip rings or affect performance. The brushes should not be allowed to wear beyond the 1/4 inch dimension shown in Fig. 6-41. Replacement is accomplished by installing a new holder, brush, lead, and terminal assembly. Note that there are both right and left hand holders and springs. Both brush holders should be to the right of their pivot pin as viewed from the outside of the slip ring end frame.

g. Capacitor

To replace capacitor, remove nut securing capacitor lead to "BAT" terminal and remove lead from terminal. Loosen retaining screw from heat sink end frame and remove capacitor from holder.

h. Ball Bearing—Drive End Frame

NOTE: Do not remove bearing unless it is going to be replaced.

To remove bearing, secure rotor in a vise using brass jaws to prevent damage to the rotor. Remove bearing from shaft using puller J-1859-02, Fig. 6-46.

To install bearing, drive new bearing onto shaft using a 15/16" deep well socket against the inner

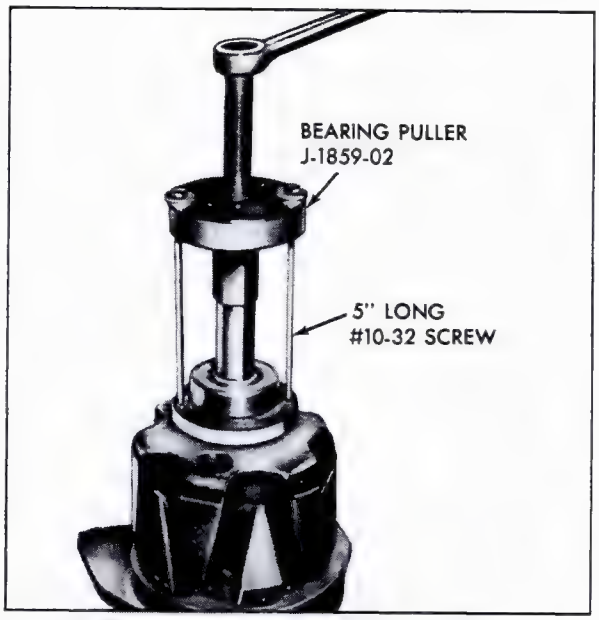


Fig. 6-46 Removing Drive End Bearing

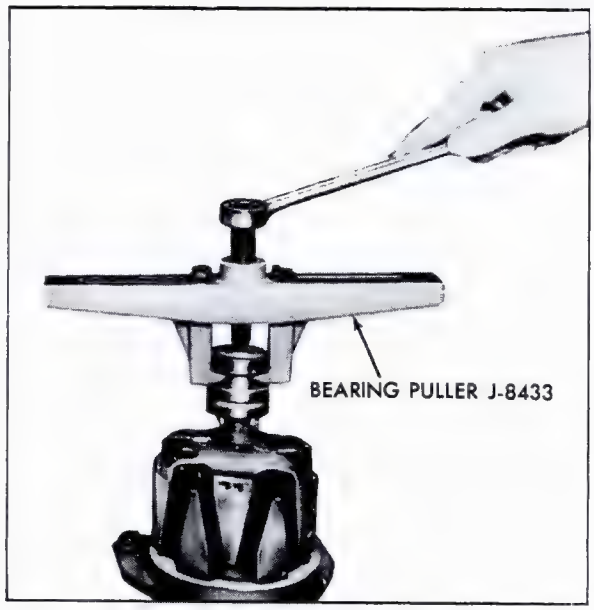


Fig. 6-47 Removing Slip Ring End Bearing

race. Drive until bearing butts against shoulder on rotor shaft.

i. Ball Bearing—Slip Ring End Frame

NOTE: Do not remove bearing unless it is going to be replaced.

To remove bearing secure rotor in a vise using brass jaws to prevent damage to the rotor. Install tool J-8433 on slip ring end frame bearing and remove bearing from shaft, Fig. 6-47.

To install bearing, drive new bearing onto shaft using a 5/8" deep well socket against the inner bearing race. Drive until bearing butts against shoulder on rotor shaft.

j. Lubrication

Under normal operating conditions, the generator will not require lubrication between overhaul periods. The grease reservoir in each end frame provides an adequate supply of lubricant for long periods of operation.

Before assembly after generator overhaul, each reservoir should be half filled with special lubricant available from your servicing Parts Warehouse.

CAUTION: Make sure that after assembly the reservoirs will be only half filled. Overfilling will cause the bearings to overheat. At overhaul periods, the bearing should be replaced with a new bearing, and the felt seals should be replaced with new ones.

If the bearings are inspected before the overhaul period, they may be re-used if the grease supply in the bearing is not low or has not been exhausted. However, if the grease supply in the bearing is low or exhausted, the bearing should be replaced with a new bearing.

CAUTION: Make sure the sealed side of the slip ring end bearing is on the side away from the grease reservoir and the open side is toward the grease reservoir. Satisfactory bearing life will be obtained only if recommended lubrication procedures are followed.

IGNITION SYSTEM

48. Distributor Removal and Installation

a. Removal

1. Remove distributor cap as shown in Fig. 6-48 and position out of way.

2. Disconnect distributor primary wire from coil.

3. Disconnect vacuum advance hose from vacuum advance unit on distributor.

4. Crank engine until copper contact on top of

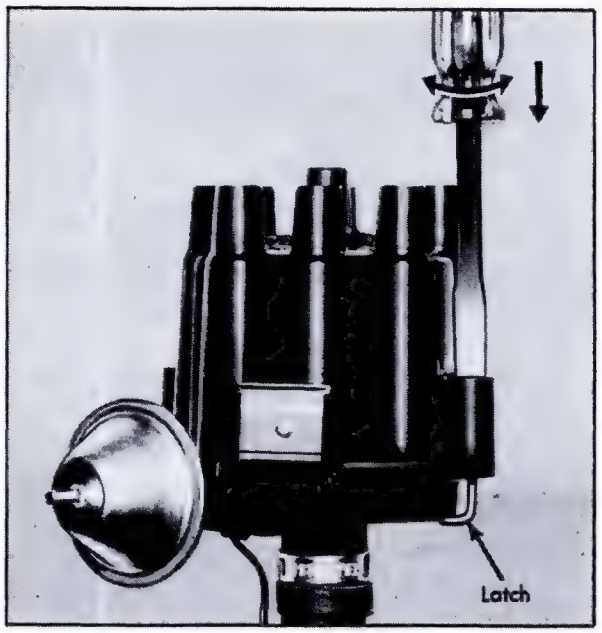


Fig. 6-48 Distributor Cap Removal

rotor points directly to No. 1 spark plug firing position. Mark the position on distributor housing.

5. Remove distributor hold down nut and clamp.
6. Lift distributor from engine.

b. Installation

1. Install distributor with copper contact on top of rotor pointing slightly counterclockwise from No. 1 spark plug firing mark. As distributor gear meshes with cam gear, rotor will turn slightly clockwise. When distributor is properly installed, rotor should point directly at No. 1 spark plug firing position mark.

NOTE: If engine has been cranked, remove No. 1 spark plug. Place thumb over port. Crank engine until compression is noticed and continue until No. 1 piston is at top dead center. In this position, the timing mark "0" on the engine front cover lines up with the scribe mark on the harmonic balancer.

2. Install distributor hold-down clamp and nut.
3. Connect distributor primary lead.
4. Install distributor cap.
5. Set timing as described in Note 62.
6. Connect vacuum advance hose to vacuum advance unit.

49. Distributor Test Information

For service departments equipped with distributor testing machines, the information on 1969 distributors is furnished as follows:

Centrifugal Advance	
Distributor Speed rpm	Distributor Spark Advance
400	0° - 2.25°
600	2.75° - 4.75°
800	5.15° - 7.15°
1000	7.40° - 9.40°
1200	8.40° - 10.30°
1400	9.25° - 11.25°
1600	10.25° - 12.25°
1800	11.00° - 13.25°
2000	12.00° - 14.00°
Vacuum Advance	
Vacuum - Inches Of Mercury	Distributor Degrees
12"	3.75° - 10.00°
14"	7.75° - 12.60°
16"	11.30° - 12.60°
18"	11.30° - 12.60°
20"	11.30° - 12.60°

NOTE: Vacuum advance starts at 8.00 inches to 10.00 inches of mercury. Maximum distributor vacuum advance is 11.30° to 12.60° at 13.00 inches of mercury or greater.

If tests indicate an improperly operating mechanism, disassemble the distributor as described in Note 50. Reassemble the distributor as described in Note 50b.

50. Distributor Disassembly and Assembly

a. Disassembly (Fig. 6-48)

1. Remove rotor from end of distributor shaft by removing two attaching screws and lockwashers.
2. Remove two weight springs and both advance weights.
3. Remove pin from gear by driving out with drift punch and hammer.

CAUTION: Distributor gear should be supported in such a way that no damage will occur to distributor shaft when driving pin out.

4. Slide gear off shaft, remove any burrs that may have been caused by removal of pin.
5. Pull shaft with cam weight base assembly from housing.
6. Remove contact point assembly and disconnect primary and capacitor lead clips.
7. Remove capacitor hold-down screw and remove capacitor and bracket from breaker plate.

8. Remove spring retainer and raise breaker plate from housing.

9. To remove vacuum advance unit, remove two attaching screws, lockwashers, and plate with ground lead.

10. Remove primary lead by prying rubber grommet out of base housing.

11. Remove felt washer from bushing in housing.

NOTE: No attempt should be made to service shaft bushing in housing.

b. Assembly

1. Place felt washer over bushing in housing.

2. Slide primary lead through opening in base of housing and seat grommet in housing.

3. Place vacuum advance unit in space provided in housing and retain in position by installing one screw in hole in mounting arm furthest from advance unit.

4. Secure distributor ground lead to vacuum advance unit with second mounting screw. Primary wire should cross over ground lead.

5. Install breaker plate assembly over bushing so that assembly is positioned over vacuum advance operating arm.

6. Install spring retainer.

7. Place capacitor and bracket in position on breaker plate and secure with one screw.

8. Install contact point assembly.

9. Install capacitor and primary leads as shown in Fig. 6-52.

10. Install shaft with camweight base assembly into housing.

11. Install gear on shaft and secure with pin. Use new pin.

12. Install both advance weights on camweight base and secure with two springs.

13. Install rotor and secure with two screws and lockwashers.

NOTE: The square and round lugs on bottom of rotor must be positioned with corresponding holes on camweight base.

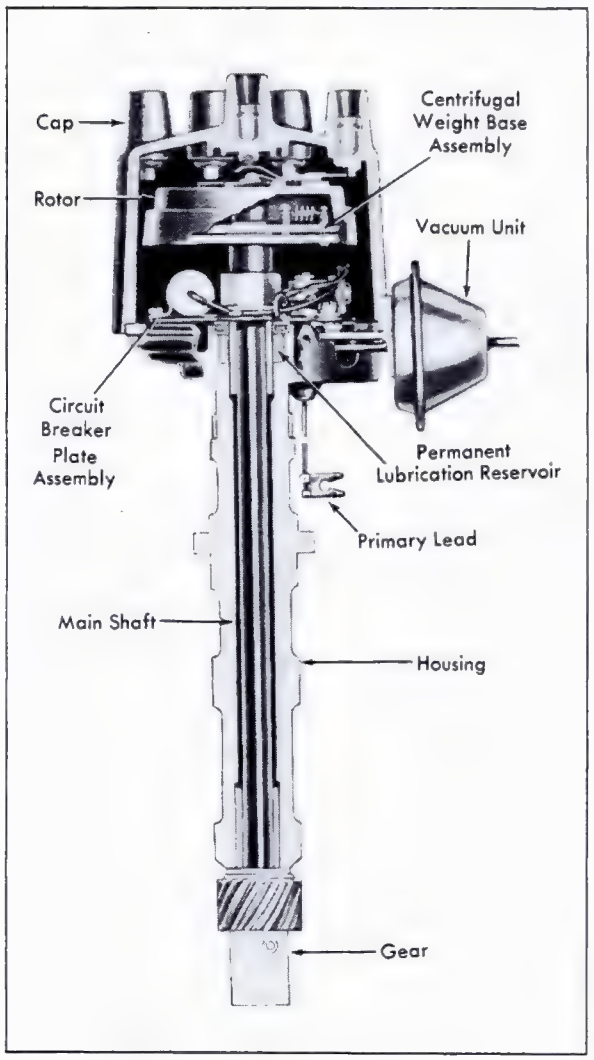


Fig. 6-49 Distributor Cut-Away View

51. Distributor Vacuum Switch (Thermal Vacuum Switch)

When coolant temperature is below 220°F carburetor vacuum is supplied to the distributor vacuum advance mechanism through thermo vacuum switch connections "C" and "D". As coolant temperature approaches 220°F, wax in the bulb expands, forcing the plunger out against the spring. When 220°F is reached, the wax has expanded enough to force the plunger against spring pressure to close off port "C" and open port "MT". Manifold vacuum, available at port "MT", is now used to operate the vacuum advance mechanism.

The fourth port on the switch is used to supply manifold vacuum to the idle speed-up device at the right rear of the carburetor.

When coolant temperature drops below 230°F, spring pressure forces the plunger back to its normal position. This is made possible because the cooling of the wax has caused it to contract back to its normal shape. Once this operation is completed, carburetor vacuum is again used to control the spark advance unit and the idle speed-up device is shut off.

This system is designed primarily to help prevent overheating by providing more precise spark control during prolonged idling periods or during unusually warm weather. Under these conditions spark advance is desirable, and since air flow through the carburetor venturies is nominal, (carburetor vacuum low), stronger manifold vacuum is used to operate the vacuum advance unit. During normal operation, carburetor vacuum operates the vacuum advance unit because it more closely follows actual engine requirements.

The additional engine speed provided by the speed-up device will also help to lower the coolant temperature.

When a car with this switch has severe overheating problems, part of the trouble could be due to an inoperative switch. If all other checks of the cooling system show the system is in order, check the vacuum switch. To check the operation of the switch, disconnect the hoses from ports "D" and "MT" while the engine is running at 2000 RPM and normal operating temperature. Check to see that vacuum is available at port "D" and not at port "MT".

In order to raise engine temperature above 230° to check the transition of vacuum sources, block the radiator with cardboard until the coolant boils. Now disconnect the hoses from ports "C" and "D". If vacuum is not available at port "D" or is available at port "C", the switch is defective and should be replaced.

52. Ignition Primary Circuit Resistance Test

Excessive voltage drop in the primary circuit will lessen the secondary output of the ignition coil, resulting in hard starting and poor performance.

1. Turn the voltmeter selector switch of the Volt-Ampere Tester to the 4 volt position.
2. Connect test leads as shown in Fig. 6-50.
3. Remove coil secondary wire from distributor and ground.
4. Close breaker points by rotating engine a fraction of a revolution at a time with starting motor.
5. Be sure all lights and accessories are turned off.
6. Turn ignition switch "On". Voltmeter should read not more than .4 volt.
7. Test ignition switch by turning it off and on several times. Voltmeter should record the same reading each time switch is turned on.

NOTE: While switch is being turned on and off, key should be jiggled in switch several times and voltmeter checked for any change in readings.

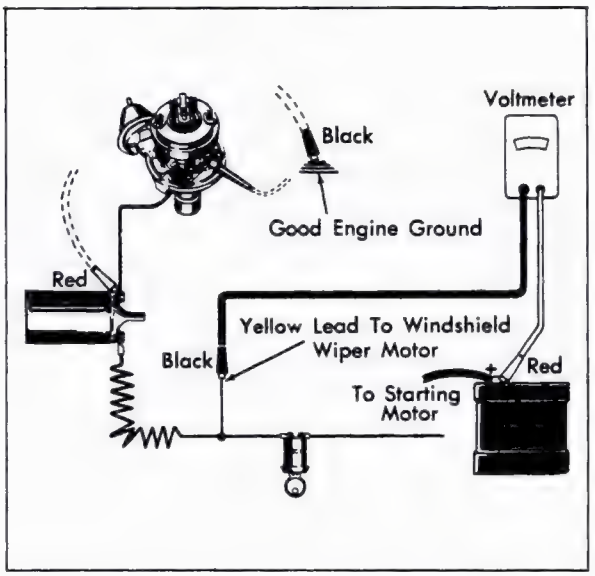


Fig. 6-50 Ignition Primary Circuit

8. Test all wires for tightness. Move them about and note any change in meter reading.
9. Remove voltmeter leads and place them across the primary wires from coil to distributor as shown by dotted leads in Fig. 6-50. Voltmeter should read less than .1 volt.

NOTE: If voltmeter reading exceeds the specified maximum, isolate the point of this resistance by placing the test leads across each connection and wire in order. The reading across a connection should be proportional to its length as compared to the length and allowable voltage drop of the entire circuit.

ENGINE TUNE-UP

Figure 6-51 illustrates the basic instrumentation required to perform the following tune-up procedures. If further testing is required such as coil tests, condensor tests, or cylinder leakage tests, the equipment manufacturer's recommendations, supplied with the test equipment to be used, should be followed for procedures. The specifications for such tests appear on page 6-48 of this manual.

The basic connections shown in Fig. 6-51 are as follows:

1. Voltmeter
   a. Positive lead to positive battery post.
   b. Negative lead to ground.
2. Timing Light
   a. Positive lead to positive battery post.
   b. Negative lead to ground.
   c. Trigger lead to No. 1 spark plug, either at plug or distributor cap. No. 1 spark plug is the first cylinder on the right side of engine.
3. Tachometer and Dwell Meter
   a. Positive lead to distributor side of coil.
   b. Negative lead to ground.

53. Cranking Voltage Test

1. Ground distributor end of coil secondary wire to keep engine from starting.
2. With ignition ON and voltmeter on 16 volt scale, crank engine.
3. Observe cranking voltage and engine speed. Voltage should be greater than 9 volts. Cranking speed should be at least 2000 RPM.
4. If cranking voltage and engine speed are correct, shut off ignition and disconnect ground on coil secondary wire.

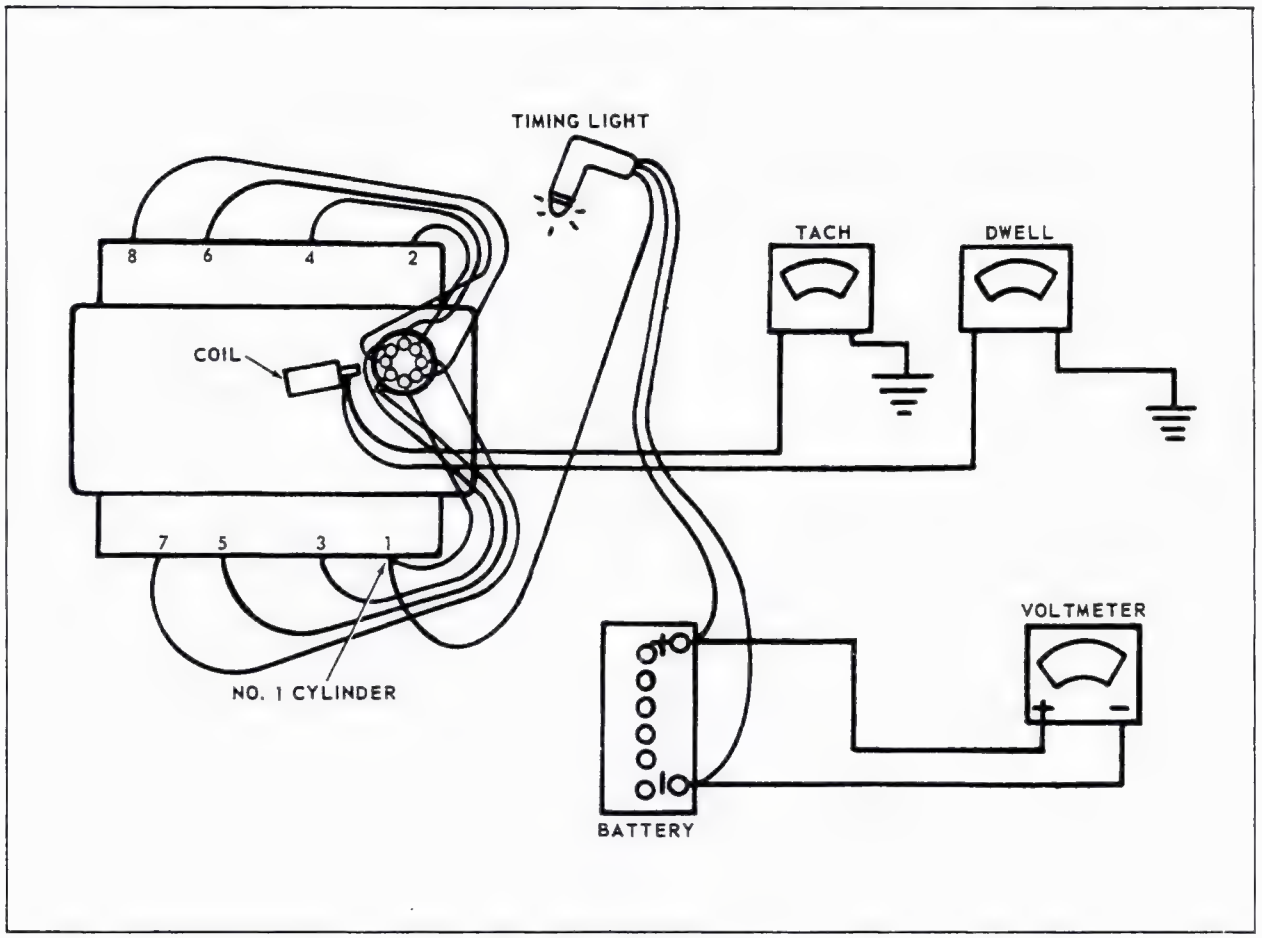


Fig. 6-51 Engine Tune-Up

5. If voltage and engine speed are not correct, further testing of the battery, Notes 14, 15 and 16 and starter circuit, note 23, must be performed.

54. Spark Plug Cleaning and Adjustment

Type R-44-N spark plugs are used on all 1969 engines.

The condition of the compound in the spark plug cleaner is important. It must be dry, because if moist, it could pack in the space between the insulator tip and shell, allowing only the tip of the plug to be cleaned. Also, the compound must be sharp to do a good cleaning job. After prolonged use, the particles of compound lose their sharp cutting edges and will not clean properly.

With the spark plug in the cleaner and the air blast turned on, press the cleaner hood down, rocking the plug. Raise the cleaner hood to the air blast position for a few seconds. Rotate the plug in its adapter and repeat the operations until the entire insulator is clean (white). It should be noted here that some spark plugs may have fused deposits on the lower insulator tips that are difficult, if not impossible, to remove. Make sure that all cleaning compound is removed from the plug.

File electrodes flat and set gap to .035 inch. The gap should be checked only with a round wire gage. Use new gaskets when installing plugs, and tighten to 25 foot-pounds.

55. Distributor Contact Points

a. Inspection

Remove distributor cap by inserting a screwdriver in upper slotted end of cap retainers, press down and turn until latches are disengaged, Fig. 6-48.

Pitted or oxidized points should be replaced. Contact points with an oily surface should be inspected for a pitted or oxidized condition. The source of oil should be located and corrected. If the points are worn evenly and show a uniform gray surface, they do not need attention, provided the dwell angle is within limits (28° to 32°).

b. Removal

1. Remove distributor cap, Fig. 6-48.
2. Remove two screws that secure rotor cap to distributor and remove cap.
3. Remove capacitor lead and primary lead from nylon insulated connection.
4. Loosen two screws that hold base of contact

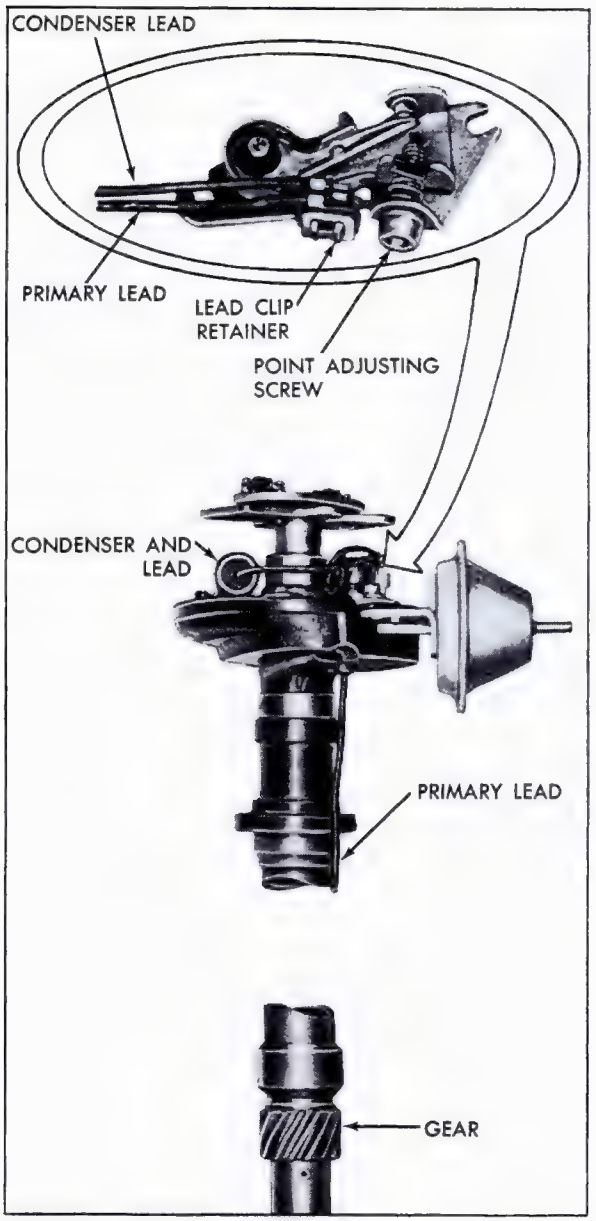


Fig. 6-52 Distributor Point Lead Retainer and Drive Gear

set assembly in place, and remove contact points.

5. Inspect condition of advance weights. If necessary, add a small amount of cam and bearing lubricant to the advance weights.

c. Installation

1. Lubricate the distributor cam with a small amount of distributor cam lubricant available from your servicing Parts Distribution Center.

2. Position replacement points under the two screws and tighten screws.

3. Install capacitor lead, primary lead and secure with spring clip retainer, Fig. 6-52.

NOTE: Leads must be properly positioned, as shown in Fig. 6-52, to eliminate interference between cap, weight base, and breaker advance plate.

4. Install rotor cap and secure with two attaching screws. Square and round lugs on the bottom of the rotor must be aligned with corresponding holes on cam weight base.

5. Position distributor shaft so that contact arm rubbing block rests on one lobe of distributor cam.

6. Insert short end of 1/8 inch Allen wrench into head of adjusting screw and turn clockwise until points close. Then turn screw counterclockwise 1/2 turn.

7. Replace distributor cap.

8. Adjust contact points as outlined, Note 61.

56. Inspect Crankcase Ventilator System

The crankcase ventilation system should be checked for cleanliness. Hoses and fitting should be cleaned or replaced if any defective conditions exist. The ventilator valve should be replaced as described in Note 104. The crankcase ventilating breather should be cleaned at each engine oil change. See Note 103 for further information.

57. Carburetor Air Cleaner

The carburetor air cleaner element should be replaced following procedures in Section 0, Note 3b to assure proper air delivery to the engine.

58. Inspect Fuel System

The fuel system should be inspecte for signs of leakage. Tighten any joints that are loose and replace hoses and lines that have been damaged.

59. Adjust Drive Belts

The drive belts should be inspected and adjusted as described in Note 11.

60. Check Manifold Heat Valve

The manifold heat valve must operate freely. If stuck open, it can cause sluggish operation of the engine during warm-up. If stuck closed, engine performance when hot will be unsatisfactory.

Heat valve may be freed up by lightly tapping. Lubricate with a mixture of graphite and alcohol. Do not use oil as it will carbonize and cause valve to stick.

61. Adjustment of Contact Points—Engine Running

a. Preferred Method

1. Connect a dwell meter to distributor primary lead.

2. Lift adjustment window and insert short end

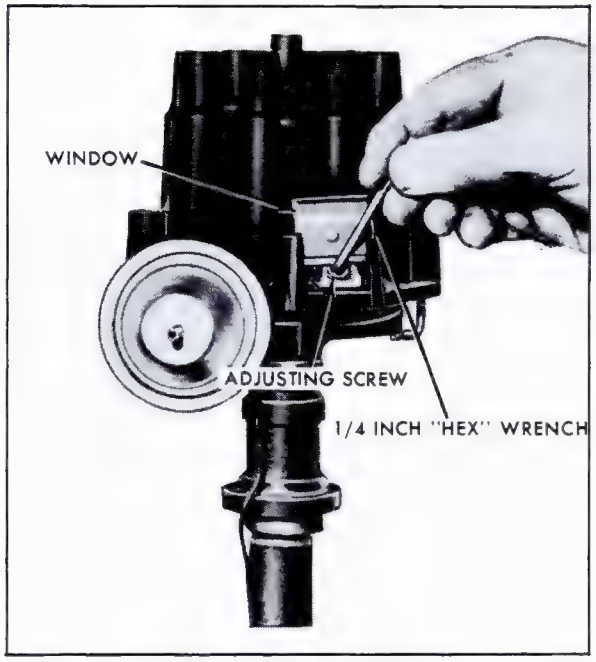


Fig. 6-53 Adjusting Distributor Points

of 1/8" Allen wrench into head of adjusting screw, Fig. 6-53.

3. Turn adjusting screw until 30° dwell angle is obtained as measured by dwell meter.

4. Last adjustment should be made by turning clockwise, in order to maintain a more uniform gap.

NOTE: It is unnecessary to check point gap, because of close manufacturing tolerances. The gap will be correct if the dwell angle is 30°.

b. Alternate Method

1. Lift adjustment window and insert short end of 1/8" Allen wrench into head of adjusting screw, Fig. 6-53.

2. Turn adjusting screw in (clockwise) until engine begins to misfire.

3. Turn wrench 3/4 turn (270°) in opposite direction (counterclockwise), and then turn clockwise 1/4 turn (90°) to obtain proper gap and dwell.

62. Ignition Timing Adjustment

1. Adjust distributor clamp nut to allow distributor to be turned by hand, but without excessive looseness.

2. Disconnect vacuum advance unit hose at distributor and place a piece of tape over end of hose. This is important, as a manifold leak will affect timing adjustments.

3. Disconnect parking brake vacuum hose at diaphragm and place a piece of tape over end of hose to prevent any air leak.

4. Insert an adapter pin alongside No. 1 or No. 4 ignition wire in distributor cap, if spark plug connectors are not available.

5. Connect a suitable timing light to adapter or connector.

NOTE: Make sure that timing marks and scribe marks are clean.

6. Connect tachometer, Fig. 6-51, to engine and set parking brake securely. Place transmission selector lever in neutral or park position.

7. Start engine and warm to operating temperature.

8. Set idle speed at 550 rpm with transmission selector lever in "DRIVE" position.

9. Observe timing light flashes on pulley in relation to notches on front cover. Rotate distributor so that light flashes when notch on pulley and center notch on front cover tab are aligned. The center notch is five degrees ahead of top dead center, Fig. 6-54.

10. Tighten clamp nut to 18 foot-pounds, and recheck timing to make sure that it did not change.

11. Remove tape from vacuum advance hose and connect hose to vacuum advance unit.

12. Remove tape from parking brake vacuum hose and connect hose to parking brake diaphragm.

13. Disconnect tachometer and timing light, and remove adapter pin or connector from engine.

63. Carburetor Adjustments

The carburetor adjustments should be checked according to Notes 91 through 99.

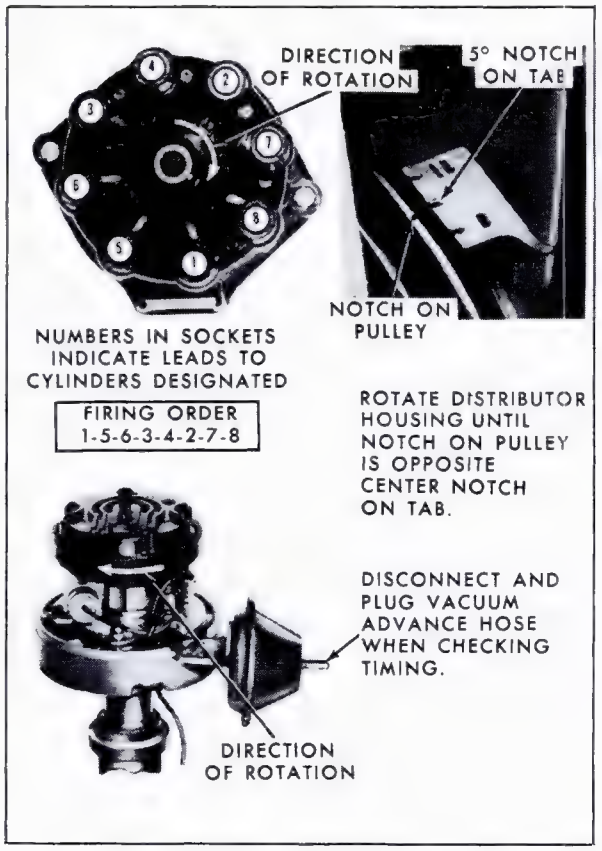


Fig. 6-54 Ignition Timing Adjustment

64. Check Charging Voltage

1. With instruments connected as in Fig. 6-51, operate engine to a speed of 1500 to 2000 RPM.
2. Observe voltmeter reading. Voltmeter should read between 13.1 and 15 volts.
3. If voltmeter reading is within correct range, shut off engine and disconnect instrumentation.
4. If voltmeter reading is not within specifications, further testing of charging system should be performed according to Notes

65. Bolt Tightening

With the engine shut off, check the tightness of the following bolts and screws:

Cylinder Head Screws	115 foot-pounds
Intake Manifold Screws	30 foot-pounds
Carburetor to Manifold Screws	14 foot-pounds
Exhaust Manifold Screws	50 foot-pounds

66. Fluid Level Check

1. Check master cylinder reservoir for proper level, fluid should be 1/2 inch below top of reservoir.
2. Check power steering pump fluid level, should be at full mark on dipstick.
3. Check battery cell level, should be at bottom of filler wells.
4. Check level of coolant in reservoir. Should be between ADD and FULL marks. Check coolant for freeze protection, should be at least -20°F.
5. Check engine oil and adjust to proper level or change as required.
6. Check transmission fluid level as indicated in Section 7, Note 7 or Note 25.

67. Visual Inspection

Visually inspect engine compartment for signs of substandard conditions. Repair conditions found. Make sure all tools are removed and instrumentation is disconnected.

68. Additional Tests

Additional tests as required should be performed following either the procedure found in the appropriate section of this manual or if no procedure is found, follow equipment manufacturer's recommendations. Sepcifications for such tests are found at the back of the appropriate section of this manual.

BATTERY CHARGING CHART

Condition	Rate	Time
Slow Charge	4 Amps	24 hours
Fast Charge	40-50 Amps	1 1/2 hours
Emergency Boost Charge	40-50 Amps	30 minutes
*Dry Battery Warm-up Charge	15 Amps	10 minutes

*Required for dry charged batteries being activated with electrolyte at a temperature below 60°F or batteries which are to go into immediate operation in below freezing temperatures.

TORQUE SPECIFICATIONS

Material No.	Application	Size	Torque
286M	Distributor Clamp Nut	5/16-24	18 Ft. Lbs.
260M	Generator Adjusting Link to Generator Screw	5/16-18	10 Ft. Lbs.
260M	Generator Support Bracket Screw	3/8-16	17 Ft. Lbs.
1112	Generator Support Bracket Nut	3/8-24	17 Ft. Lbs.
—	Spark Plugs (Type R-44-N)	14 mm	25 Ft. Lbs.
280M	Starter Motor to Engine Block	7/16-14	46 Ft. Lbs.
Special	Starter Motor Brace Mounting Screw	5/16-18	12 Ft. Lbs.
Special	Starter Motor Brace Mounting Nut	1/4-20	70 In. Lbs.
260M	Battery Hold Down Screw	5/16-18	6 Ft. Lbs.
260M	Battery Ground Strap to Frame Screw	3/8-16 Self-Tapping	22 Ft. Lbs.

NOTE: Refer to back of manual, page 16-1, for bolt and nut markings and steel classification.

SPECIFICATIONS

Items	All Cars Unless Otherwise Noted
BATTERY	
Capacity, Ampere Hours	74
Plates, Number Per Cell	15
Terminal Grounded	Negative
Volts	12
Full Charge Specific Gravity 80°F	1.250-1.280
Cables, Gage	2
STARTING MOTOR	
Brush Spring Tension, oz.	35
Free Speed	
Volts	10.6
Amperes	70-99
RPM	7800-12,000
Cranking Power at 0°F	3600 Watts
SOLENOID SWITCH	
Hold-in Winding	14.5-16.5 amp. 10V
Both Windings	41-47 amp. 10V
GENERATOR (All Cars When Not Equipped With Air Conditioning Except Fleetwood 75 and Commercial Chassis)	
Rated Output:	
Amperes	42
Volts	14
Field Current Draw:	
Amperes	2.2-2.6
Volts	12
Temperature, F°	80
Pulley Ratio	2.74:1
GENERATOR (Fleetwood 75 Commercial Chassis and All Others When Equipped With Air Conditioner)	
Rated Output:	
Amperes	55
Volts	14
Field Current Draw:	
Amperes	2.2-2.6
Volts	12
Temperature, F°	80
Pulley Ratio	2.85:1
GENERATOR (Optional on All Series)	
Rated Output:	
Amperes	63
Volts	14
Field Current Draw:	
Amperes	2.8-3.2
Volts	12
Temperature, F°	80
Pulley Ratio w/A.C.	2.85:1
w/o A.C.	2.74:1
GENERATOR (Commercial Chassis Optional Generator)	
Rated Output:*	
Amperes	130
Volts	14
Field Current Draw:	
Amperes	2.2-2.4
Volts	12
Temperature, F°	80
Pulley Ratio w/A.C.	2.85:1
REGULATOR (All Except Commercial Chassis with Optional Generator)	
Normal Range, Volts (at 125°F)	13.5-14.4
Lower Contact Point Setting, Volts (Lower Than Upper Contact Setting)	.1 to .3
REGULATOR (Commercial Chassis with Optional Generator)	
Normal Range, Volts (at 125°F)	13.6-14.3
Closing Relay Voltage	4.5-6.5
DISTRIBUTOR	
Rotation	Clockwise
Dwell Angle, Set to	30°
Range	28°-32°
Capacitor Capacity in Microfarads	.18-.23
Centrifugal Advance, Dist.	
Degrees Start	0°-2.25° at 400 RPM
Maximum	12°-14° at 2000 RPM
Initial Timing	5° BTDC
Vacuum Advance, Inches of Mercury	
Start	8.00"-10.00"
Full	13.00"
Maximum Advance	12.25°
Firing Order	1,5,6,3,4,2,7,8
COIL	
Amperes Draw	
Engine Running	1.25
Primary Resistance, Ohms	1.77-2.01
Secondary Resistance Ohms	3000-20,000
Primary Resistance at 80°F, Ohms (In Wiring Harness)	1.3-1.35
SPARK PLUGS	
A.C. Type Number	R44-N
Gap, Inches	.035
Thread	14 mm
Torque	25 foot-pounds

*If generator output is checked without regulator this value should be 5% to 10% higher.

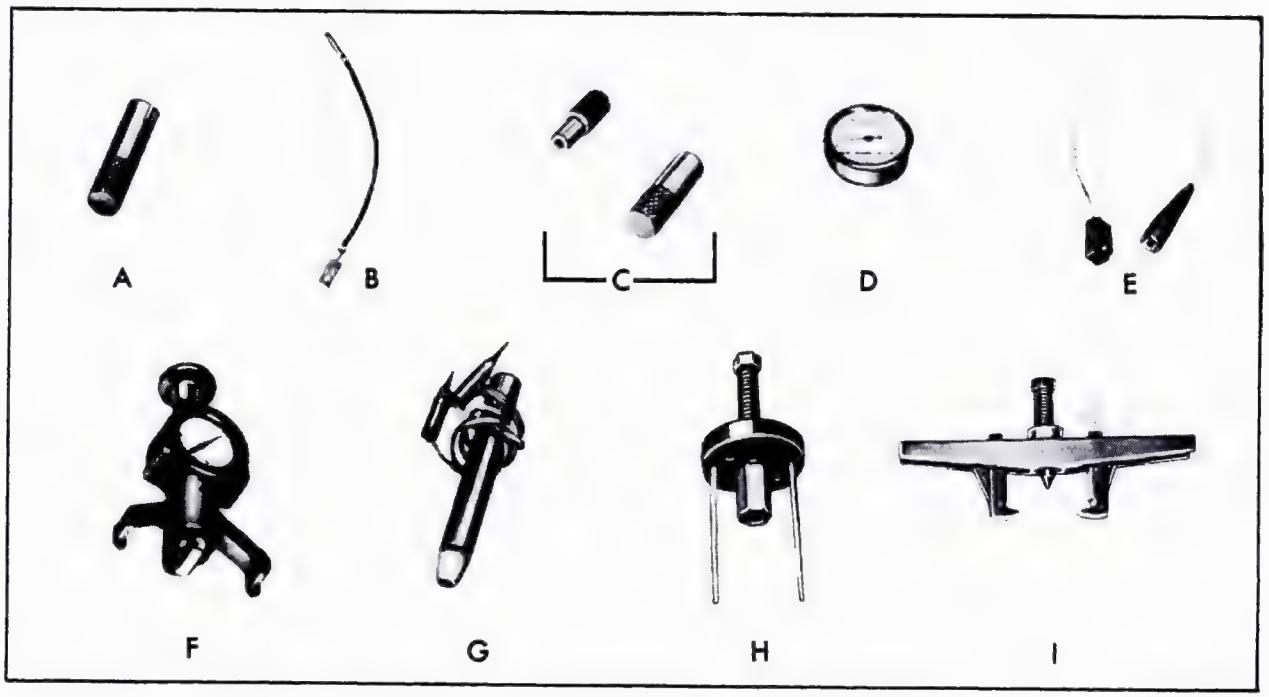


Fig. 6-55 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-9600-2	Diode Installer	E	J-21053	Generator Field Adapter
B	J-9782-1	Regulator Adapter Jumper	F	J-7316	Belt Tension Gage
C	J-9717-1 and 2	Diode Remover Set	G	J-21008	Diode Tester
D	J-8529	Voltage Regulator Temperature Gage	H	J-1859-02	Puller
			I	J-8433	Puller

GENERAL INFORMATION

The 1969 Cadillac engine fuel system, Fig. 6-56, covered in this section includes fuel pump with integral filter, fuel line, carburetor and intake manifold. Covered in this section are related components of these assemblies.

Fuel Requirements

The 1969 Cadillac is designed to operate efficiently on "premium" grade fuels commonly sold in the United States and Canada. Use of fuel that is too low in anti-knock quality will result in "spark knock". Since the anti-knock quality of all premium grade gasolines is not the same, and factors such as terrain and air temperature affect operating efficiency, some knocking may result under unusual circumstances even though the proper grade of fuel is used.

On cars to be used in foreign countries, there is a possibility that the best available fuels are so low in anti-knock quality that it may be necessary to lower the compression ratio of the engine. This is accomplished by installing low compression pistons, available through servicing Parts Distribution Centers. If persistent knocking is encountered, even with low compression pistons and the best fuel available, it may be necessary to retard spark timing. Engine fuel requirements are reduced by approximately one octane number (Motor Method) for each 2-1/2 degrees that spark timing is retarded from the normal 5 degree setting. Do not retard beyond top dead center.

Do not "power time" the engine, as variations in fuels, altitude and weather conditions will affect octane requirements. Never advance the spark beyond 5° B.T.D.C.

Storage Precautions

When a car is to be put in storage for 30 days or longer, it is best to drain all gasoline from the fuel system, including carburetor, fuel filter, fuel

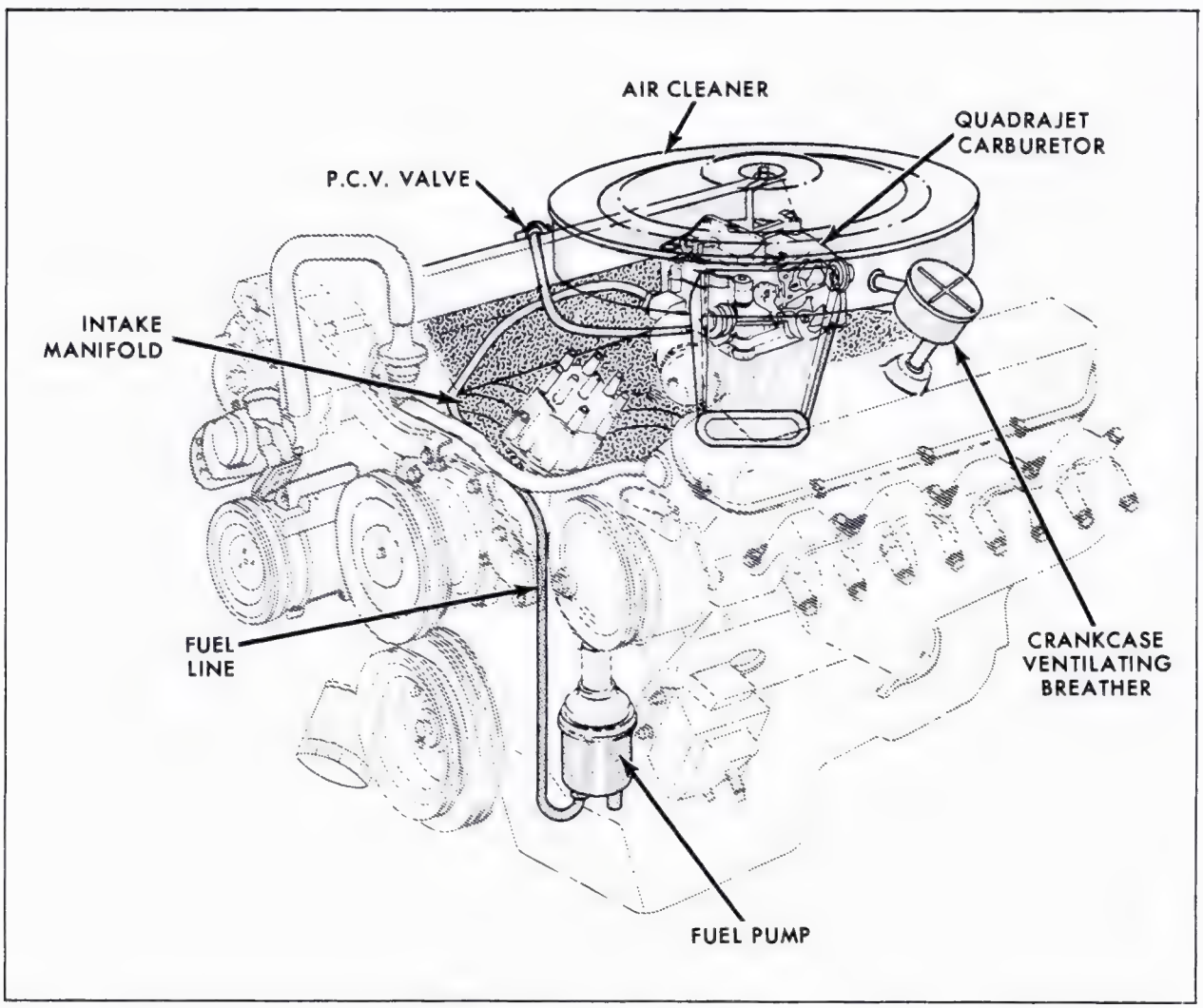


Fig. 6-56 Fuel System Components

pump, lines and tank. This assures freedom from gum deposits that would be formed by evaporation of the fuel. See Section 0, Page 0-4 for further precautions.

Fuel Pump

The fuel pump, Fig. 6-61, is mounted on the left front of the engine on all 1969 Cadillac cars and incorporates a large fuel reservoir. The pump rocker arm is driven by an eccentric bolted to the camshaft. Fuel is drawn into the fuel pump on the upward stroke of the diaphragm as the rocker arm is moved downward by the cam eccentric working against the force of the spring. The diaphragm is forced downward by the spring during the delivery stroke of the pump, and exerts pressure on the fuel equal to the spring load as the eccentric travels to minimum stroke. This design provides a smooth, even flow of fuel to the carburetor.

Most engine operating conditions do not require a full travel of the diaphragm in the fuel pump. Whenever this condition occurs, an overriding spring keeps the rocker arm in contact with the cam eccentric at all times while the diaphragm displaces fuel equal to engine demand.

The fuel pump is a sealed unit and is serviced only as an assembly.

Air conditioner-equipped cars use a fuel pump with a bypass passage that continually returns part of the fuel to the fuel tank. This bypass also returns fuel vapors that may form in the lines under high operating temperatures.

Fuel Filter

The fuel filter for 1969 is an integral component of the fuel pump, Fig. 6-56, mounted inside the pump at the outlet fitting. It filters out dirt particles in excess of approximately .002 inch in diameter. Should the fuel filter become clogged with dirt, fuel flow will stop since there is no bypass passage. As a further precaution against dirt in the carburetor, or fuel line a fuel inlet screen is provided behind the inlet nut of the carburetor, Fig. 6-74.

The fuel filter in the pump should be replaced each 12,000 miles or 12 months, preferably in the spring, see Note 100.

The fuel inlet screen does not require periodic replacement but should be cleaned whenever the carburetor is overhauled. Also, it should be inspected when fuel flow problems are encountered.

Carburetor Air Cleaner

All 1969 Cadillac cars use a carburetor air cleaner incorporating a replaceable paper element to remove dirt from the air before it enters the carburetor and engine, Fig. 6-61. A new paper air cleaner element should be installed in these cars every 24,000 miles.

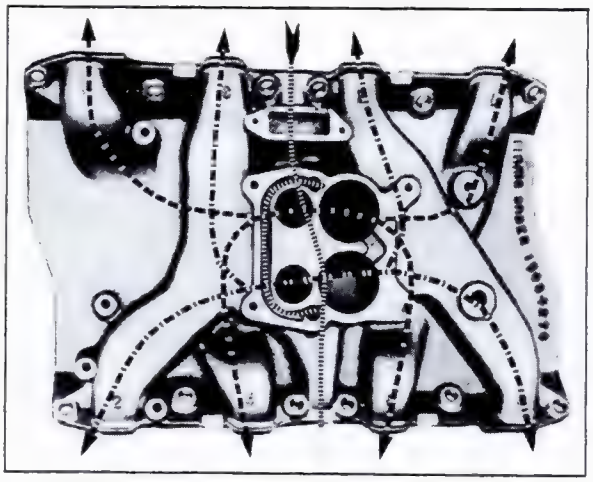


Fig. 6-57 Intake Manifold Passages

More frequent replacement of the paper element may be necessary if the car is driven constantly in dusty areas.

Fuel Intake Manifold

The intake manifold is designed to provide passages that are short and nearly equal in length. Each pair of bores, one primary and one secondary, feeds fuel to four cylinders as shown in Fig. 6-57.

During engine warmup, the intake manifold is heated by exhaust gases passing from the right cylinder bank to the left through a crossover passage cast into the center of the manifold. Pre-heating the fuel-air mixture in this manner contributes to uniform fuel distribution and more complete vaporization. This feature is controlled by a thermostatically controlled heat valve located at the junction of the right exhaust manifold and exhaust pipe. The valve controls the flow of exhaust gases from the right cylinder head. During the engine warmup period, the valve is closed, forcing hot exhaust gases through a ribbed heat passage in the intake manifold to heat the intake air-fuel mixture.

A branch of this passage conducts exhaust gases up to the carburetor base. These hot gases warm the carburetor in the region of the primary throttle valves and idle ports to prevent stalling due to ice formation during engine warm-up on cool, humid days. Better performance and economy are thereby provided when the engine is cold.

Transmission Downshift Switch

All cars utilize a rotary transmission downshift

switch that is activated at 60° throttle opening by the throttle adapter plate. This switch controls the detent downshift of the transmission through an electrical circuit that energizes the transmission detent solenoid.

The switch is located at the left of the carburetor and secured by two screws to a support attached to the intake manifold. Adjustment of the switch is covered in Note 97.

Throttle Dash Pot

Certain transmission and vehicle speed conditions are such that sudden release of the accelerator pedal might cause the engine to return too quickly to idle speed, with subsequent stalling of the engine; to prevent this stalling, a throttle dash pot assembly is incorporated ahead of the throttle linkage. Adjustment of this device is covered in Note 98.

Idle Speed-Up Device

Cars equipped with air conditioning have a vacuum-operated idle speed-up control attached to the carburetor. This device increases the engine idle rpm to 900 when the water temperature becomes excessive (approximately 220°F). This provides increased engine cooling and guards against possible engine overheating during idling while in neutral or park. Adjustment of this device is covered in Note 99.

General Description Cadillac Quadrajet Carburetor (Fig. 6-58)

The four barrel Quadrajet carburetor used on all 1969 Cadillac cars has two stages of operation. The primary (fuel inlet) side has small bores with a triple venturi set-up equipped with plain tube nozzles. Its metering principles are similar to those of other carburetors using the venturi principle. The triple venturi stack up, plus the smaller primary bores, give a stable fuel control in the idle and economy ranges of operation. Fuel metering in the primary side is accomplished with metering rods positioned by a power piston responsive to manifold vacuum.

The secondary side has two very large bores, to supplement fuel flow from the primary bores. The air valve principle is used in the secondary side for metering control, which means that fuel is metered in direct proportion to the air passing through the secondary bores.

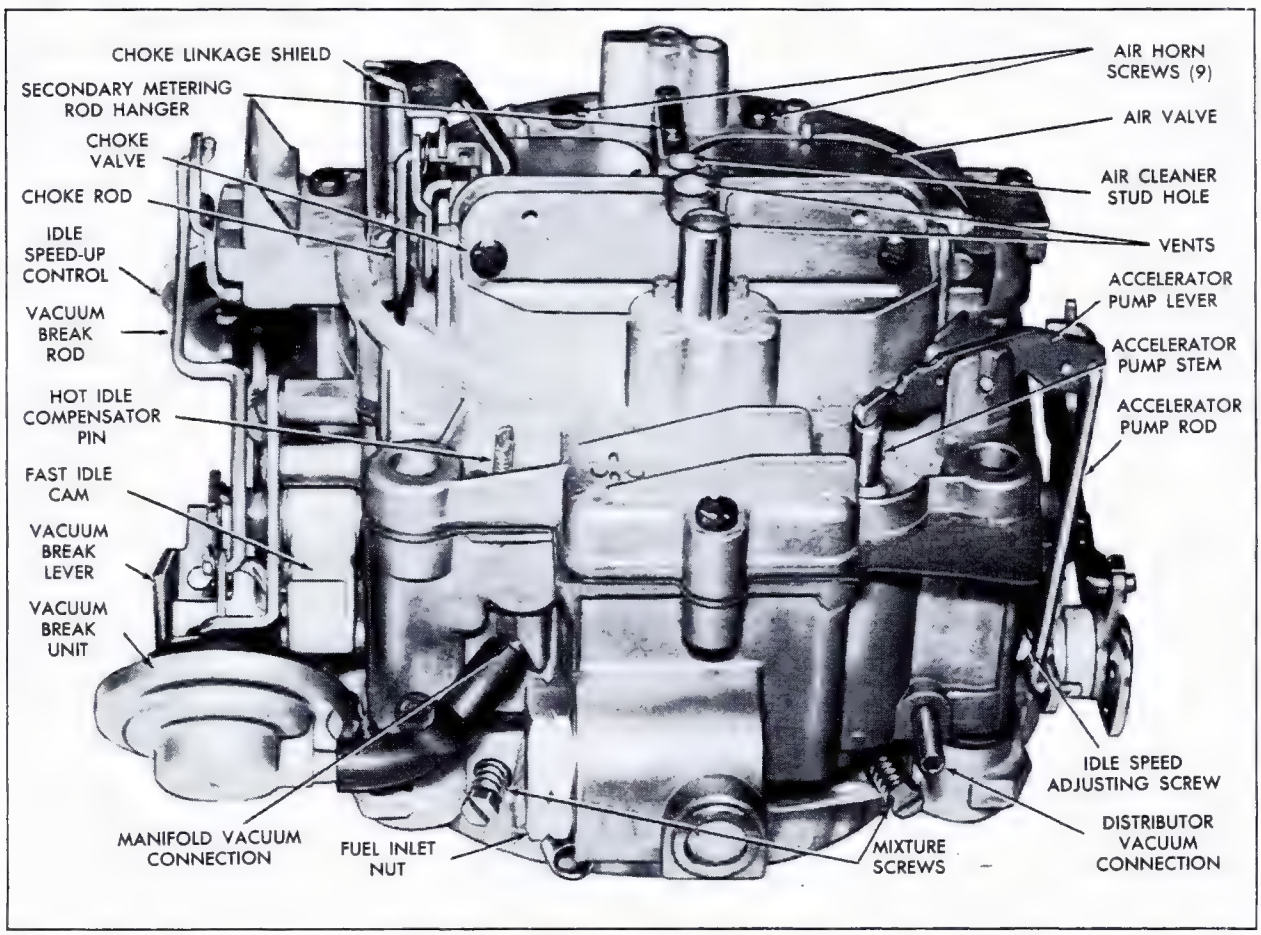


Fig. 6-58 Quadrajet 4MV Carburetor

The fuel reservoir (bowl) is centrally located. The float system uses a single float pontoon. The float needle has a synthetic tip which gives added protection against flooding problems caused by dirt.

The primary side of the carburetor has six systems of operation. They are float, idle, main metering, power, pump, and choke. The secondary side has one metering system which supplements the primary main metering system and receives fuel from a common float chamber.

Float System (Figs. 6-59 and 6-60)

The Quadrajet carburetor has a centrally located float reservoir with a single pontoon float and a conventional float needle valve and seat. The fuel bowl is centered between the primary bores and is adjacent to the secondary bores as shown in Fig. 6-59.

The float system consists of a float chamber, pontoon assembly made of a closed cellular plastic material, float hinge pin, a float needle valve and seat, and a float valve pull clip. The float system operates as follows:

Fuel from the engine fuel pump enters the carburetor fuel inlet passage in Fig. 6-60. It passes through the inlet screen, and needle seat.

As fuel fills the float bowl to the prescribed fuel level, the float pontoon rises and forces the fuel inlet valve closed, shutting off all full flow. As fuel is used from the float chamber, the float drops and allows more incoming fuel to enter the float bowl until the correct fuel level is reached. This cycle continues, constantly maintaining a positive fuel level in the float bowl.

A float needle pull clip, fastened to the float valve, hooks over the center of the float arm. Its purpose is to assist in lifting the float valve off its seat.

A plastic filler block is located in the top of the float chamber in the area just above the fuel inlet. This block prevent fuel slosh on severe brake applications or turning maneuvers. This maintains a constant fuel level during these maneuvers, to prevent stalling.

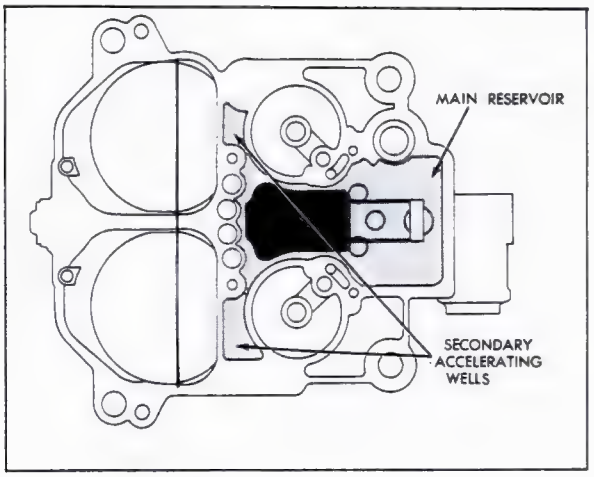


Fig. 6-59 Fuel Reservoir

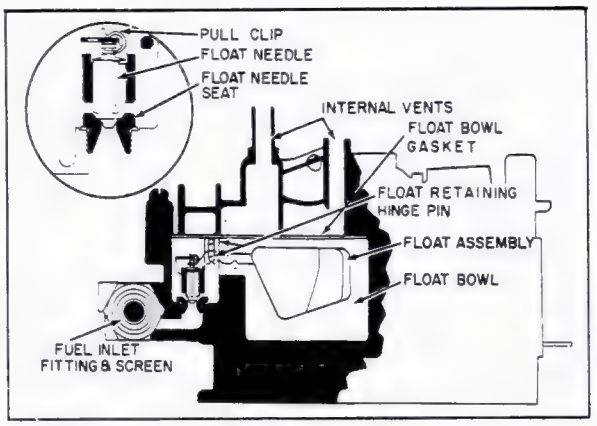


Fig. 6-60 Float System

The carburetor float chamber is internally vented. The internal vent tubes are located in the primary bore section of the carburetor air horn just above the float chamber. The purpose of the internal vent is to balance incoming air pressure beneath the air cleaner with air pressure acting on fuel in the float bowl. Thereby maintaining a balanced air/fuel mixture ratio during part throttle and power operation, because the pressure acting upon the fuel in the float bowl will be balanced with the air flow through the carburetor bores. The internal vent tubes allow the escape of fuel vapors in the float chamber during hot engine operation. This prevents fuel vaporization from causing excessive pressure build-up in the float bowl, which could result in excessive fuel spillage into the manifold.

Idle System (Fig. 6-61)

The Quadrajet carburetor has an idle system on the primary side (fuel inlet side) of the carburetor to supply the correct air/fuel mixture ratios

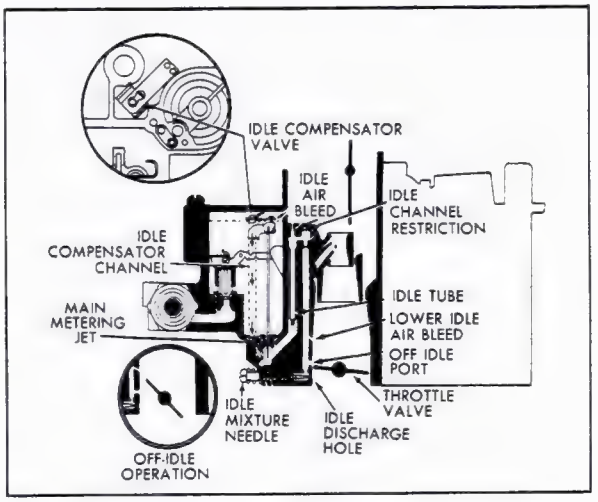


Fig. 6-61 Idle System

during idle and off-idle operation. The idle system is used during this period because air flow through the carburetor venturi is not great enough to obtain efficient metering from the main discharge nozzles.

The idle system is used only in the two primary bores of the carburetor. Each bore has a separate and independent idle system. They consist of idle tubes, idle passages, idle air bleeds, idle channel restrictions, idle mixture adjustment needles, and idle discharge holes.

During curb idle, the throttle valve is held slightly open by the idle speed adjusting screw. The small amount of air which passes between the primary throttle valve and bore is regulated by this crew to give the engine the desired idle speed. Since the engine requires very little air for idle and low speeds, fuel is added to the air to produce a combustible mixture by the direct application of vacuum (low pressure) from the engine manifold to the idle discharge hole below the throttle valve. With the idle discharge holes in a very low pressure area and the fuel in the float bowl vented to atmosphere (high pressure), the idle system operates as follows:

Fuel is forced from the float bowl down through the primary metering jets into the main fuel well. It passes from the main fuel well into the idle passage where it is picked up by the idle tubes.

The fuel is metered at the tip of the idle tubes and passes up through the idle tubes. The fuel then crosses over in the air horn to the idle down channels. Air is bled in here through a calibrated idle restriction. The mixture passes down through the channel restriction.

This mixture then passes down the idle channel past the lower idle air bleed holes and off-idle discharge ports, located just above the primary throttle valves, where it is mixed with more air. The air/fuel mixture moves down to the idle needle discharge holes, where it enters the carburetor bores and mixes finally with air passing around the slightly open throttle valve. It then enters the intake manifold and is conducted to the engine cylinders as a combustible mixture.

The idle mixture needles are adjustable and control the amount of fuel mixed with the air going to the engine. Turning the mixture screw clockwise (inward) decreases the fuel discharge (gives a leaner mixture) and turning the mixture screw counter-clockwise (outward) increases (enrichens) the idle fuel mixture.

Off Idle Operation

As the primary throttle valves are opened from curb idle to increase engine speed, additional fuel is needed to combine with the extra air entering the engine. This is accomplished by the slotted off-idle discharge ports. As the primary throttle valves open, they pass by the off-idle ports, gradually exposing them to high engine vacuum below the throttle valves. The additional fuel added from the off-idle ports mixes with the increasing air flow past the opening throttle valves to meet increased engine air and fuel demands.

Further opening of the throttle valves increases the air velocity through the carburetor venturi sufficiently to cause low pressure at the lower idle air bleeds. As a result, fuel begins to discharge from the lower idle air bleed holes and continues to do so throughout operation of the part throttle to wide open throttle ranges, supplementing the main discharge nozzle delivery.

The idle needle holes and off-idle discharge ports continue to supply sufficient fuel for engine requirements until air velocity is high enough in the venturi area to obtain efficient fuel flow from the main metering system.

Hot Idle Compensator (Fig. 6-61)

The hot idle compensator is located in a chamber adjacent ot the primary throttle bores. Its purpose is to offset enriching effects caused by excessive fuel vapors during hot engine operation.

The compensator consists of a thermostatically controlled valve and a bi-metal strip which is heat sensitive. The valve closes off an air channel between the air cleaner and a point below the primary throttle valves. The compensator valve assembly is held in place by the air horn. A cork gasket seals the valve assembly against air leaks.

Normally the compensator valve is held closed by tension of the bi-metal strip. During extremely hot engine operation, excessive fuel vapors entering the engine manifold cause richer than required mixtures, resulting in rough engine idle and stalling. At a predetermined temperature, when extra air is needed to offset the enrichening effects of fuel vapors, the bi-metal strip bends and unseats the compensator valve. This uncovers the air channel to a point below the throttle valves. This allows enough air to be drawn through a calibrated orifice into the engine manifold to offset the richer mixtures and maintains a smooth engine idle. When the engine cools and the extra air is not needed, the bi-metal strip closes the valve and operation returns to normal.

In order to insure proper idle adjustment when the engine is hot, the compensator valve must be held closed. To do this, a finger may be placed over the compensator pin located on top of the air horn above the fuel inlet. If no drop in engine RPM is noted on a tachometer, the valve is closed. If the valve is open, hold valve closed by holding pin down for proper idle adjustment.

Main Metering System (Fig. 6-62)

The main metering system supplies fuel to the engine from off-idle to wide open throttle operation. The Quadrajet carburetor has two bores that feed fuel and air during this range. The two primary bores of the carburetor meter fuel through the venturi principle. This design allows the use of multiple venturi for finer and more stable metering control during light engine loads.

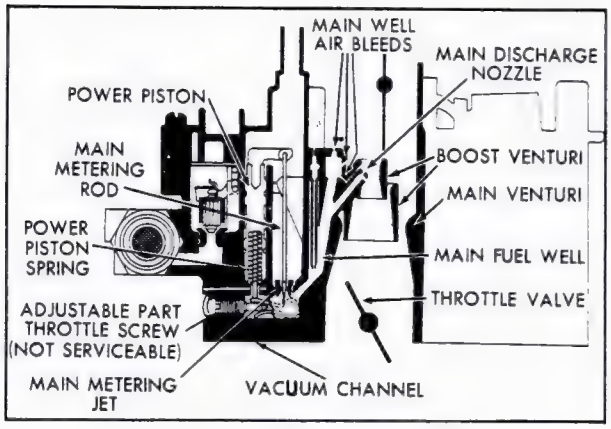


Fig. 6-62 Main Metering System

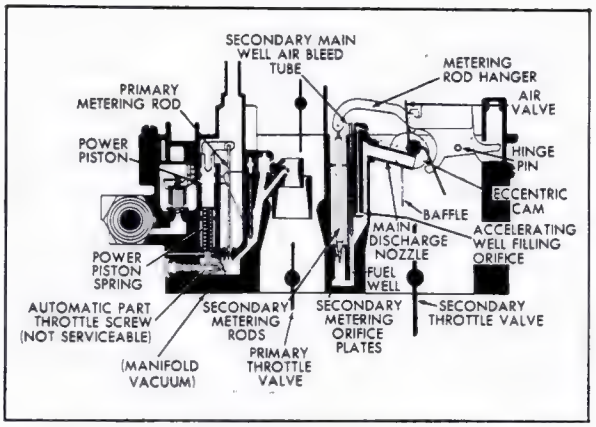


Fig. 6-63 Power System

The main metering system is in operation at all times when air flow through the venturi is high enough to maintain efficient fuel flow from the main fuel discharge nozzles. It begins to feed fuel when the idle system can no longer meet the engine requirements.

The main metering system consists of main metering jets; vacuum operated metering rods; main fuel well; main well air bleeds; fuel discharge nozzles; and triple venturi. The system operates as follows:

During cruising speeds and light engine loads, engine manifold vacuum is high. Manifold vacuum holds the power piston and main metering rods down in contact with the adjustable part throttle screw and in the main metering jets. Manifold vacuum is supplied through a channel to the vacuum operated power piston connected to the primary main metering rods. Fuel flow from the float bowl is metered between the metering rods and the main jet orifice.

As the primary throttle valves are opened beyond the off-idle range, allowing more air to enter the engine manifold, air velocity increases in the carburetor venturi. This causes a drop in pressure in the large venturi which is increased many times in the double boost venturi. Since the low pressure (vacuum) is now in the smallest boost venturi, fuel flows from the main discharge nozzles as follows:

Fuel flows from the float bowl through the main metering jets into the main fuel well and is bled with air from the vent at the top of the main well and side bleeds. The fuel in the main well is mixed with air from the main well air bleeds and then passes through the main discharge nozzle into the boost venturi. At the boost venturi the fuel mixture then combines with the air entering the engine through the carburetor bores and passes through the intake manifold and on into the engine cylinder as a combustible mixture.

Power System (Fig. 6-63)

The power system in the Quadrajet carburetor provides mixture enrichment for power requirements under acceleration or high speed operation. The richer mixture is supplied through the main metering system in the primary and secondary sides of the carburetor.

The power system located in the primary side consists of a vacuum piston and spring located in a cylinder connected by a passage to intake manifold vacuum. The spring located beneath the vacuum operated power piston tends to push the piston upward against manifold vacuum.

An "adjustable part throttle" feature has been designed to allow each carburetor to be individually calibrated at time of assembly. Each Cadillac carburetor will be adjusted by the manufacturer to provide the most ideal air-fuel ratio for low exhaust emissions. The adjustable part throttle screw is used to raise or lower the power piston and metering rods to provide this ratio. Upon completion of this adjustment the access hole is sealed and no further adjustment should be attempted. This adjustment should not be attempted in the field.

On part throttle and cruising ranges, manifold vacuum is sufficient to hold the power piston down against spring tension so that the larger diameter of the metering rod tip is held in the main metering jet orifice. Mixture enrichment is not necessary at this point. However, as engine load is increased to a point where mixture enrichment is required, the spring tension overcomes the vacuum pull on the power piston and the tapered primary metering rod tip moves upward in the main metering jet orifice. The smaller diameter of the metering rod tip allows more fuel to pass through the main metering jet and enrich the mixture flowing into the primary main wells and out the main discharge nozzles.

When manifold vacuum rises and mixture enrichment is no longer needed, the vacuum overcomes the power piston spring tension and returns the larger portion of the metering rod into the metering jet orifice and back to normal economy ranges. However, as the engine speed and load increases further, the primary side of the carburetor can no longer meet the engine air and fuel requirements. To meet these demands, the secon-

dary side of the carburetor is used. The secondary side contains throttle valves, spring loaded air valves, metering orifice plates, secondary metering rods, main fuel wells with air bleed tubes, fuel discharge nozzles, and accelerating wells and tubes. The secondary side operates as follows:

When the engine reaches a point where the primary bores cannot meet engine air and fuel demands, the primary throttle lever, working through connecting linkage to the secondary throttle shaft lever, begins to open the secondary throttle valves. As air flows through the secondary bores creating a low pressure (vacuum) beneath the air valve, atmospheric pressure on top of the air valve forces the air valve open against spring tension. This allows the required air for increased engine speed to flow past the air valve.

When the air valve begins to open, the upper edge of the air valve passes the accelerating well port. As the valve passes the port it exposes the port to manifold vacuum. The port will immediately start to feed fuel from the accelerating wells.

The accelerating ports prevent a momentary leanness as the valve opens and the secondary nozzles have not begun to feed fuel.

The secondary main discharge nozzles (one for each secondary bore) are located just below the air valve and above the secondary throttle valves. Being in the area of lowest pressure, they begin to feed fuel as follows:

When the air valve begins to open, it rotates a plastic cam attached to the center of the main air valve shaft. The cam pushes upward on a lever attached to the secondary main metering rods, raising the metering rods out of the secondary orifice plates. Fuel flows from the float chamber through the secondary orifice plates into secondary main wells, where it is mixed with air from the main well tubes at the bottom of the main wells. The air-blended-fuel mixture travels from the main wells to the secondary discharge nozzles and into the secondary bores. Here fuel mixture is mixed with air traveling through the secondary bores to supplement the air/fuel mixture delivered from the primary bores, and then goes on into the engine manifold and on to the engine cylinders as a combustible mixture.

As the throttle valves are opened further, and engine speeds increase, increased air flow through the secondary side of the carburetor opens the air valve to a greater degree, which in turn lifts the secondary metering rods further out of the orifice plates. The metering rods are tapered so that fuel flow through the secondary metering orifice plates is directly proportional to air flow through the secondary carburetor bores. In this manner correct air/fuel mixtures to the engine through the secondary bores can be maintained by the depth of the metering rods in the orifice plates.

There are three other features incorporated in the secondary metering system which are as follows:

1. The main well bleed tubes extend below the fuel level in the main well. These bleed air into the fuel in the well to blend the fuel with air quickly for good atomization as it leaves the secondary discharge nozzles.

2. The secondary metering rods have a slot milled in the side to insure adequate fuel supply in the secondary fuel wells. These are necessary because, when the air valve is in the closed position, the secondary metering rods are nearly seated against the secondary metering orifice plates. During hot engine idle or hot soak the fuel could boil out of the fuel well. The milled slot allows enough fuel to by-pass the orifice plate to keep the main well filled during this period. This insures immediate fuel delivery from the secondary fuel wells at all times.

3. A baffle plate is used in the secondary bores. Its purpose is to provide good fuel distribution by preventing too much fuel from going to the front of the engine.

Air Valve Dashpot Operation (Fig. 6-64)

The secondary air valve is connected to a dashpot (called the vacuum break unit) by a rod, to control the opening rate of the air valve and prevent any secondary discharge nozzle lag.

Whenever manifold vacuum is above approximately 5" - 6" Hg, the vacuum break diaphragm system is seated. However, when the secondary valves are opened and manifold vacuum drops below the 5" - 6" point, the spring in the vacuum break unit will force the diaphragm and stem off its seat. The rate of movement off the seat is controlled by a restriction in the cover of the vacuum break unit.

When the diaphragm is seated, it pulls the rod to the end of the slot in the air valve shaft lever. As the air valve starts to open, when the secondary throttle valves are opened, the restriction in the cover will restrict the air movement to the back side of the diaphragm and slow down the opening of the air valve.

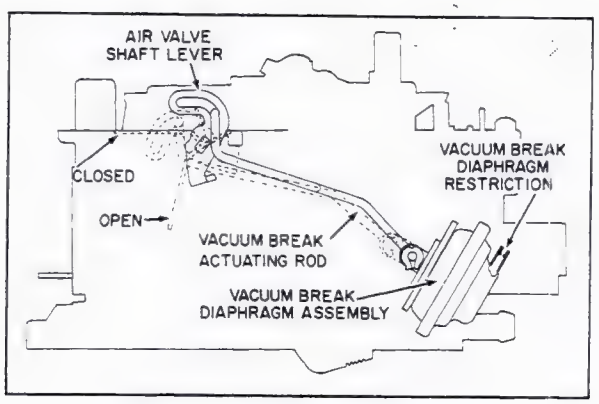


Fig. 6-64 Air Valve Dashpot Operation

Accelerating Pump System (Fig. 6-65)

During quick acceleration, when the throttle is opened rapidly, the air flow and manifold vacuum change almost instantaneously. The fuel, which is heavier, tends to lag behind causing a momentary leanness. The accelerator pump is used to provide the extra fuel necessary for smooth operation during this time.

The accelerating pump system is located in the primary side of the carburetor. It consists of a spring loaded pump plunger and pump return spring, operating in a fuel well. The pump plunger is operated by a pump lever on the air horn which is connected directly to the throttle lever by a pump rod.

When the pump plunger moves upward in the pump well, as happens during throttle closing, fuel from the float bowl enters the pump well through a slot in the top of the pump well. It flows past the synthetic pump cup seal into the bottom of the pump well. The pump cup is a floating type which moves up and down on the pump plunger head. When the pump plunger is moved upward, the flat on top of the cup unseats from the flat on the plunger head and allows free movement of fuel through the inside of the cup into the bottom of the pump well. This also vents any vapors which may be in the bottom of the pump well so that a solid charge of fuel can be maintained in the fuel well beneath the plunger head.

When the primary throttle valves are opened, connecting linkage forces the pump plunger downward. The pump cup seats instantly and fuel is forced through the pump discharge passage, where it unseats the pump discharge check ball and passes on through the passage to the pump jets located in the air horn where it sprays into the venturi area of each primary bore.

It should be noted the pump plunger is spring loaded. The upper duration spring is balanced with the bottom pump return spring so that a smooth sustained charge of fuel is delivered during acceleration.

The pump discharge check ball seats in the pump discharge passage during upward motion of the pump plunger so that air will not be drawn into passage; otherwise, a momentary acceleration lag could result.

During high speed operation, a vacuum exists at the pump jets. A cavity just beyond the pump jets is vented to the top of the air horn, outside the carburetor bores. This acts as a suction break so that when the pump is not in operation fuel will not be pulled out of the pump jets into the venturi area. This insures a full pump stream when needed and prevents any fuel "pull over" from the pump discharge passage.

Choke System (Fig. 6-66)

The Quadrajet choke valve is located in the primary side of the carburetor. It provides the correct air/fuel mixture enrichment to the engine for quick cold engine starting and during the warm-up period. The air valve is locked partially closed until the engine is thoroughly warm and choke valve is wide open. The air valve can open a maximum of 8" during warm-up to permit increased performance.

The choke system consists of a choke valve located in the primary air horn bore, a vacuum diaphragm unit, fast idle cam, connecting linkage, air valve lockout lever and a thermostatic coil. The thermostatic coil is connected to the intermediate choke shaft and lever assembly. Choke operation is controlled by the combination of intake manifold vacuum, the off-set choke valve, temperature, and throttle position.

The thermostatic coil located on the engine manifold is calibrated to hold the choke valve closed when the engine is cold.

NOTE: To close the choke valve, the primary throttle valves have to be opened to allow the fast idle cam follower to by-pass the steps on the fast idle cam and come to rest on the highest step of the cam.

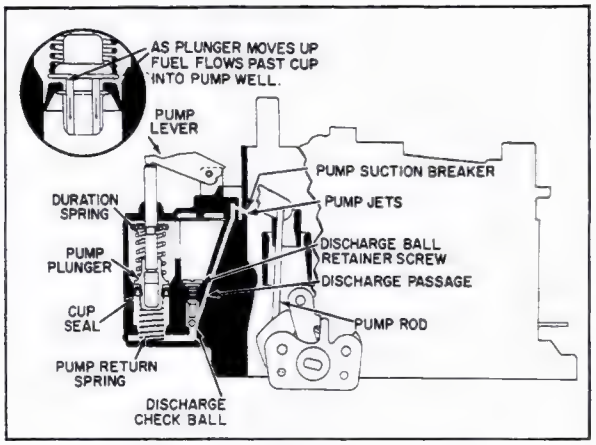


Fig. 6-65 Accelerator Pump System

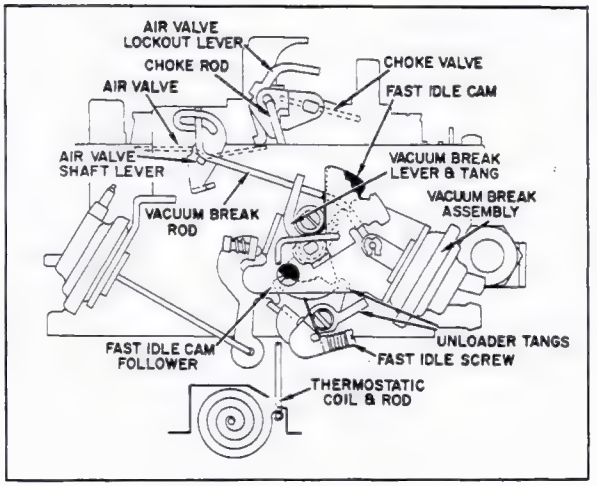


Fig. 6-66 Choke System

When the choke valve is closed, the air valve lock-out lever is weighed so that a tang on the lever catches the upper edge of the air valve and keeps the air valve almost closed.

During engine cranking, the choke valve is held closed by the tension of the thermostatic coil. This restricts air flow through the carburetor to provide a richer starting mixture. When the engine starts and is running, manifold vacuum applied to the vacuum diaphragm unit mounted on the float bowl will open the choke valve to a point where the engine will run without loading or stalling.

This gives the engine sufficient fast idle and correct fuel mixture for running until the engine begins to warm up and heat the thermostatic coil. As the thermostatic coil on the engine manifold becomes heated, it relaxes its tension and allows the choke valve to open further because of intake air pushing on the off-set choke valve and the counterweight effect of the linkage and choke lever. Choke valve opening continues until the thermostatic coil is completely relaxed, at which point the choke valve is wide open.

When the engine is thoroughly warm, the choke coil allows the vacuum break lever to come down. When the choke shaft lever moves toward the up position, the end of the choke rod strikes a tang on the air valve lock-out lever. As the rod moves to the end of its travel, it pushes the lock-out tang upward, unlocking the air valve.

The choke system is equipped with an unloader mechanism which is designed to open the choke valve partially if the engine should become loaded or flooded. To unload the engine, the accelerator pedal must be depressed to the floor so that the throttle valves are held wide open. A tang on a lever on the choke side of the primary throttle shaft contacts the fast idle cam and, working through the intermediate choke shaft, forces the choke valve slightly open. This allows extra air to enter the carburetor bores and pass into the engine manifold and cylinders to lean out the fuel mixture so that the engine will start.

SERVICE INFORMATION

69. Carburetor Removal and Installation

a. Removal

1. Remove air cleaner and gasket.
2. Disconnect fuel line at carburetor.
3. Disconnect choke coil rod from carburetor by removing two choke housing to manifold attaching screws. Carefully lift choke coil assembly out of pocket. Remove rod from hole in lever.
4. Disconnect distributor, power brake and transmission modulator vacuum lines from front and rear of carburetor.
5. Disconnect throttle return spring and throttle rod or cable at throttle adapter plate.
6. Release PCV valve hose clamp attached to front of carburetor and remove hose from fitting.
7. Remove transmission downshift switch as described in Note 96a.
8. Remove two front screws and two rear screws that hold carburetor to intake manifold and lift carburetor off manifold.
9. Remove carburetor, gasket, and stainless steel shim. Discard the carburetor gasket. The stainless steel shim may be used again if it is not warped, cracked or corroded and can be cleaned.

b. Installation

1. Clean surface of intake manifold, carburetor, and shim of any dirt, carbon or gasket material.
2. Place new carburetor gasket on top of manifold with side marked "top" facing up, Fig. 6-67.
3. Place cleaned stainless steel shim on top of gasket with side marked "top" facing up.
4. Connect PCV valve hoses to fitting on front of carburetor and secure with clamp.
5. Position carburetor on intake manifold.
6. Install four mounting screws to intake manifold. Tighten screws evenly. Tighten front screws to 10 foot-pounds and rear screws to 14 foot-pounds.

NOTE: This torque must be as specified to allow for accurate installation of calibrated choke coil rod.

7. Connect the distributor vacuum lines to distributor vacuum nipples on the carburetor. Divertor valve connects to front of carburetor and power brake and transmission modulator vacuum hoses connect to rear of carburetor.
8. Install choke coil rod into vacuum break lever as the choke assembly is installed to the manifold. Tighten choke assembly to manifold with attaching screws.

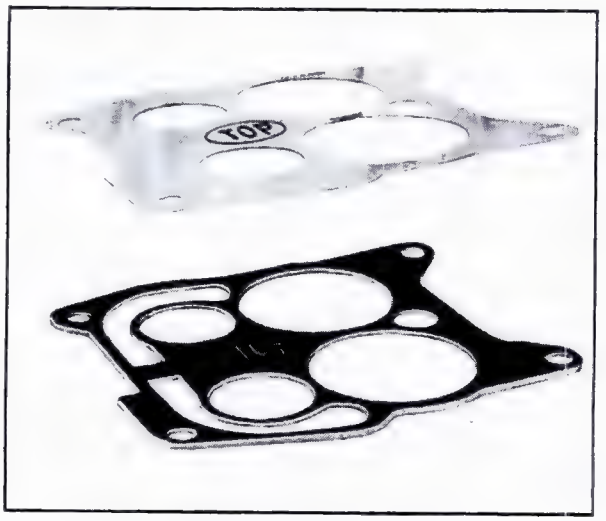


Fig. 6-67 Carburetor Gasket and Shim

9. Install transmission downshift switch as described in Note 96b.

10. Connect carburetor fuel line at carburetor and tighten all threaded fittings securely.

11. Connect throttle linkage and return spring(s).

12. Connect PCV valve hose to valve and secure with clamp.

13. Place air cleaner gasket in position and install air cleaner.

Carburetor Disassembly

NOTE: Place carburetor on proper holding fixture.

70. Air Horn Removal

1. On air conditioned cars, remove idle speed up device from carburetor by removing screw securing it to the air horn. Disengage pull rod from lever.

2. Remove horseshoe clip from upper end of choke rod, disconnect choke rod from upper choke shaft lever and remove choke rod from bowl. Use a thin screwdriver to push the lower choke lever outward to help remove the rod.

3. Remove horseshoe clip from vacuum break rod and remove rod.

4. Remove horseshoe clip from upper end of pump rod, then disconnect pump rod from pump lever and lever on primary throttle shaft.

5. Remove secondary metering rod hanger screw and remove metering rods with hanger.

6. Remove nine air horn to bowl attaching screws, two long screws, five short screws, two countersunk screws. Two countersunk attaching screws are located next to the primary venturi. Remove secondary locknut guard by removing one self tapping screw.

7. Remove air horn by lifting straight up. Air horn gasket should remain on bowl for removal later.

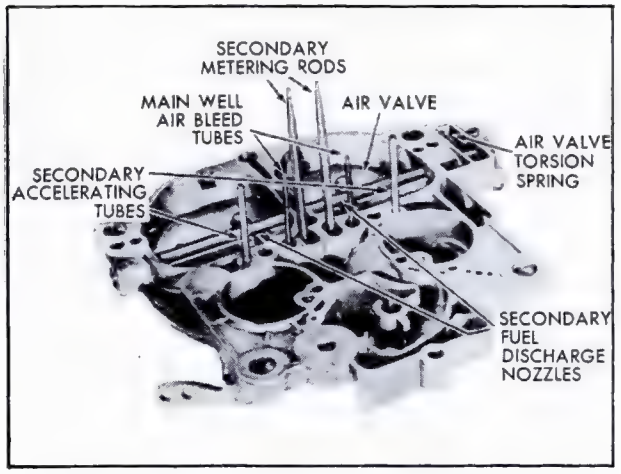


Fig. 6-68 Air Horn Assembly

CAUTION: Care must be taken not to bend the small tubes protruding from air horn, Fig. 6-68. These are permanently pressed into the casting.

71. Air Horn Disassembly

NOTE: Further disassembly of the air horn is not required for cleaning purposes and is not recommended. If part replacement is required, proceed as follows:

1. Remove choke valve attaching screws and then remove choke valve and shaft.

2. Remove pump lever roll pin, then pump lever.

3. Remove air valve lockout lever roll pin and remove lever.

CAUTION: Air valves and air valve shaft, set screw and spring should not be removed.

72. Float Bowl Disassembly

1. Remove air horn assembly as described in Note 70.

2. Remove pump plunger from pump well, Fig. 6-69.

3. Remove air horn gasket from dowels on secondary side of bowl, then remove gasket from around power piston and primary metering rods.

4. Remove air horn gasket, taking care to work gasket around power piston.

5. Remove pump return spring from pump well.

6. Remove hot idle compensator and cork O-ring from float bowl.

7. Remove plastic filler over fuel inlet needle and seat.

8. Remove power piston retainer clip and remove power piston and primary metering rods, using needle nosed pliers to pull straight up on metering rod hanger directly over power piston, Fig. 6-70. Remove power piston spring from well.

9. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotating rod to remove from hanger.

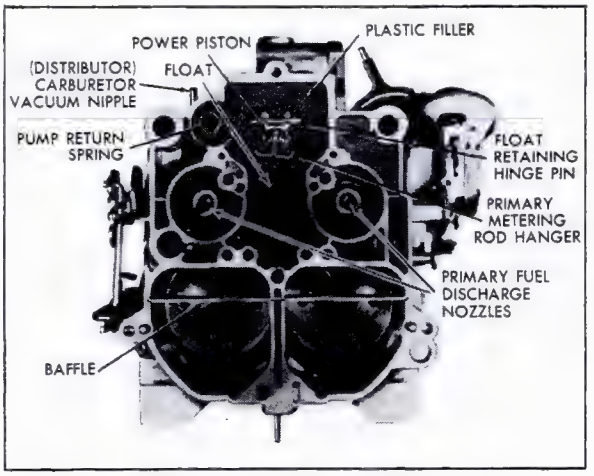


Fig. 6-69 Float Bowl Assembly

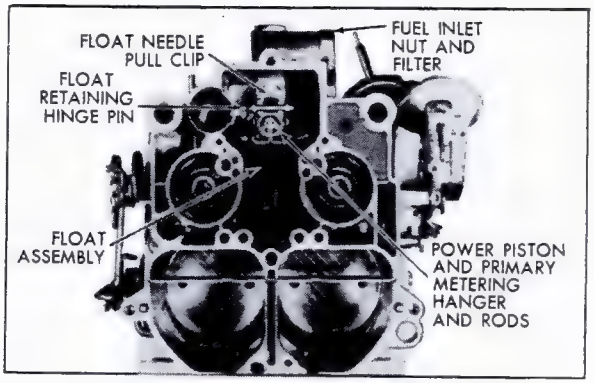


Fig. 6-70 Float Bowl Partially Disassembled

See inset of Metering Rod Assembly, Fig. 6-74.

10. Remove float assembly and inlet needle by pulling up on retaining hinge pin. Do not remove inlet needle seat unless it is damaged, in which case it and fuel needle must be replaced as an assembly. If needle seat is to be removed, use Fuel Inlet Needle Seat Remover, J-22769, Fig. 6-71.

11. Remove primary metering jets, Fig. 6-72. No attempt should be made to remove secondary metering plates.

12. Remove pump discharge check ball retainer screw and check ball.

13. Remove baffle from secondary side of bowl.

14. Remove vacuum hose from vacuum break assembly and from tube connection on bowl.

15. Remove retaining screw from vacuum break assembly and remove assembly from float bowl.

NOTE: If further disassembly of choke lever mechanism is necessary, spread the retaining ears on bracket next to vacuum break assembly, then remove vacuum break assembly from lever.

16. On air conditioned cars, remove idle speed up lever.

17. Remove choke rod actuating lever from inside of float bowl well.

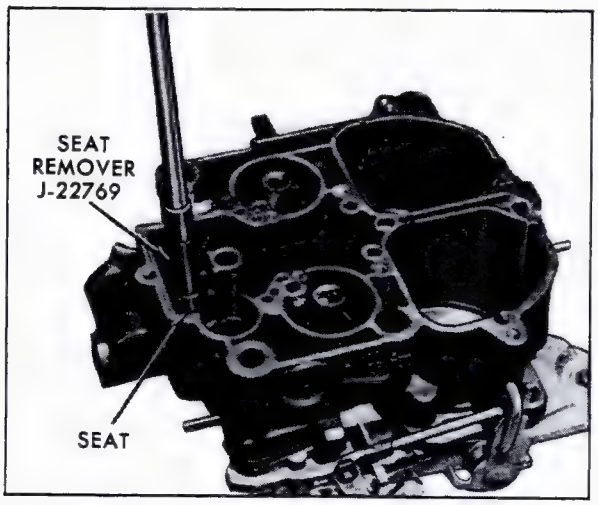


Fig. 6-71 Removing Needle Valve Seat

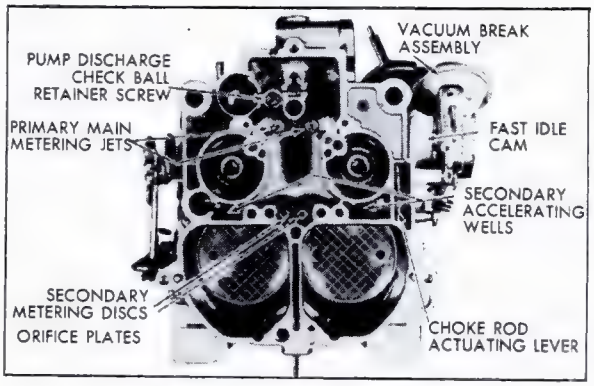


Fig. 6-72 Float Bowl Disassembled

18. Remove fuel inlet nut, gasket and screen.

19. Turn bowl over and remove throttle body by removing three throttle body to bowl attaching screws. See Fig. 6-73.

NOTE: Be careful when inverting bowl assemlby as smallest venturi protrudes beyond the gasket surface.

20. Remove throttle body to bowl insulator gasket.

73. Throttle Body Disassembly

1. Remove idle mixture screws and spring. Idle mixture screws have long taper (except Eldorado) and should be handled carefully to avoid damage.

CAUTION: Extreme care must be taken to avoid damaging throttle valves.

NOTE: No further disassembly of the throttle body is required or desirable. Under no circumstance should the plug at the front of the throttle body be removed to adjust the screw behind it. The screw is factory set to provide good exhaust emission control to pass U.S. Government standards. Since proper adjustment

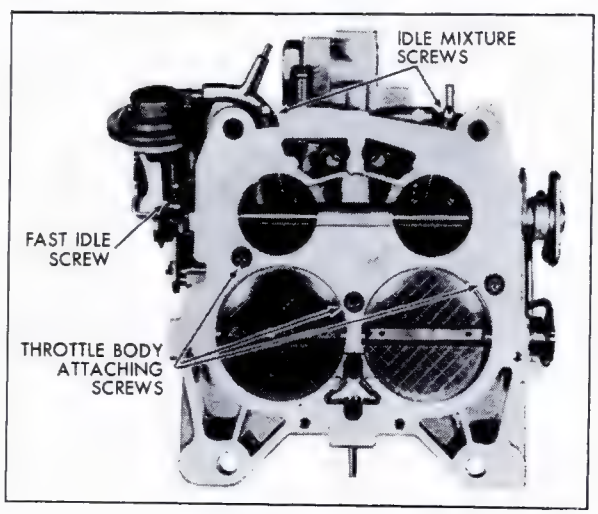


Fig. 6-73 Throttle Body

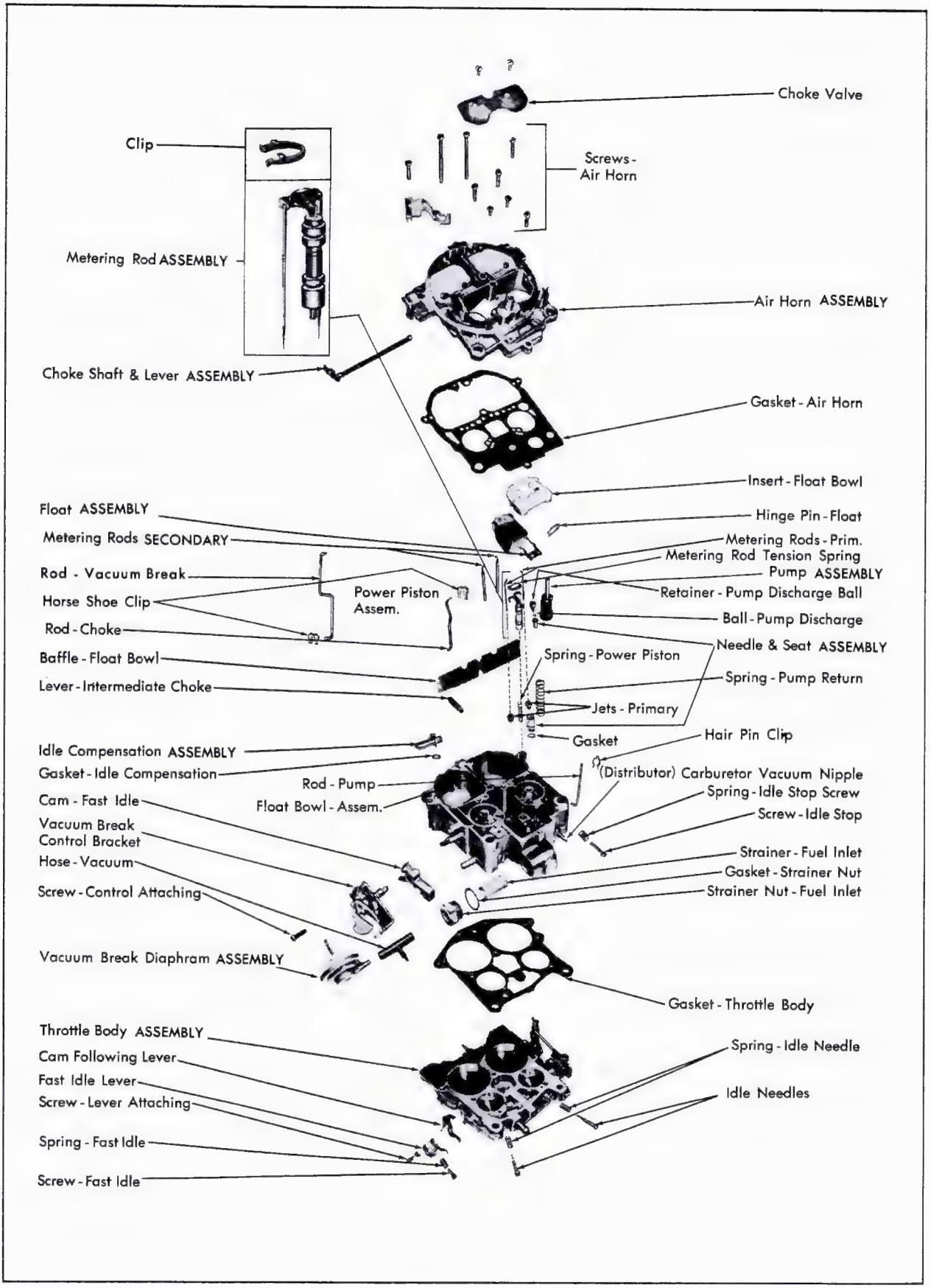


Fig. 6-74 Quadrajet 4MV Exploded View

of this screw can only be made on an Exhaust Emission Dynamometer or Carburetor Flow Box a new throttle body should be installed if any damage to the existing throttle body is encountered. Refer to Note 76 when installing a new throttle body.

74. Carburetor Cleaning and Inspection

1. Thoroughly clean carburetor castings and metal parts, Fig. 6-74 in an approved cold immersion type carburetor cleaner.

CAUTION: Rubber parts, plastic parts, and pump plungers, should NOT be immersed in carburetor cleaner. However, the delrin cam on the air valve shaft will withstand normal cleaning in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

3. Inspect idle mixture needles for damage.

4. Examine fuel inlet needle and seat for wear. Replace if necessary with new needle and seat assembly.

5. Inspect upper and lower surfaces of carburetor castings for damage.

6. Inspect holes in levers for excessive wear or out of round conditions. If worn, levers should be replaced.

7. Examine fast idle cam for wear or damage.

8. Check air valve for binding conditions. If air valve is damaged, air horn assembly must be replaced.

9. Check all throttle levers and valves for binds or other damage.

10. Clean plastic parts only in washing gas or kerosene.

Carburetor Assembly

75. Throttle Body Assembly

1. Install idle mixture needles and springs until lightly seated. Back out needles four turns as a preliminary idle mixture adjustment.

76. Float Bowl Assembly

1. Install new throttle body to bowl insulator gasket on bowl, being certain gasket is properly positioned over two locating dowels.

2. Install throttle body, making certain that it is properly located over dowels on float bowl; then install three throttle body to bowl screws and tighten evenly and securely.

NOTE: If a new (service) throttle body is used, be sure to perform step 21, of this note.

Place carburetor on proper holding fixture.

3. Install fuel inlet screen, new gasket, and inlet nut. Tighten nut securely.

4. Install air conditioning idle speed up lever on cast pin located as shown in Fig. 6-95, if carburetor is so equipped.

NOTE: If vacuum break diaphragm was removed from bracket, slide vacuum break diaphragm between retaining ears and bend ears down slightly to hold securely.

5. Install fast idle cam on vacuum break assembly. Be sure arm of vacuum break lever is located in cut-out area of fast idle cam.

6. Connect choke rod (plain end) to choke rod actuating lever, then -- holding choke rod with grooved end pointing inward -- position choke rod actuating lever in well of float bowl and install choke assembly, engaging shaft with hole in actuating lever. Install retaining screw and tighten securely. Remove choke rod from lever for installation later.

7. Install vacuum hose tee to connections on bowl and vacuum break assembly.

8. Install baffle in secondary side of bowl with notches toward top.

9. Install pump discharge check ball and retainer screw in passage next to pump well.

10. Install primary main metering jets.

11. If fuel inlet needle seat was removed, use new needle seat gasket and position new seat on Fuel Inlet Needle Seat Remover and Installer, J-22769. Carefully screw needle seat into float bowl, Fig. 6-71.

12. Install fuel inlet needle and pull cip.

13. Install float by sliding float lever under float needle pull clip. Pull clip should be positioned on the hinge pin side. With float lever in pull clip, hold float assembly at toe and install hinge pin from pump well side.

14. Perform float level adjustment as described in Note 79.

15. Install power piston spring in power piston well. If primary main metering rods were removed from hanger, re-install, making sure that tension spring is connected to top of each metering rod. See Fig. 6-74. Install power piston assembly in well with metering rods properly positioned in metering jets. Install power piston retainer on top of power piston.

16. Install plastic filler over fuel inlet needle, pressing downward until seated properly.

17. Install pump return spring in pump well.

18. Install hot idle compensator O-ring seal in recess of bowl and position hot idle compensator on top.

19. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl.

20. Install pump plunger in pump well to complete float bowl assembly.

21. Whenever a service throttle body is installed, the following adjustment procedures must be followed carefully:

a. Seat the power piston assembly by pushing down on top of metering rod hanger.

b. At the front of the throttle body, in the

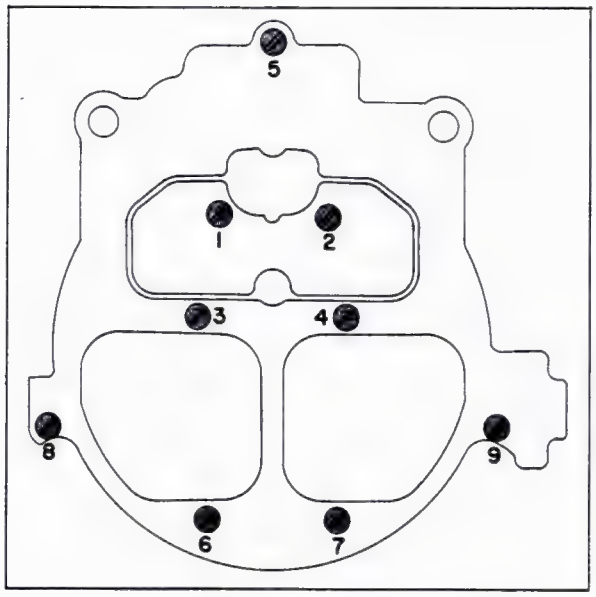


Fig. 6-75 Air Horn Screws Tightening Sequence

center, an adjusting screw is visible. This screw is plugged off except on service throttle bodies.

c. Back off the screw sufficiently so no motion of the power piston is felt.

d. Making sure the power piston assembly is completely down, turn the adjusting screw inward until it comes in contact with the power piston through a lever arrangement (concealed in the throttle body) and resistance to any further inward movement of the screw is noticed. Any further movement of the screw will begin to raise the power piston and can be felt.

e. From this point, turn the adjusting screw inward exactly two (2) more turns. This completes the adjustment. Install the welsh plug, furnished with the throttle body, over the adjusting screw and stake in place to conceal the screw.

f. Proceed with the remaining carburetor adjustments.

77. Air Horn Assembly

1. Install the following, if removed.
Pump lever with roll pin.
Choke shaft, choke valve and two attaching screws, air valve lockout lever and roll pin.

78. Air Horn to Bowl Installation

1. Place air horn assembly on bowl carefully, positioning vent tubes and accelerating well tubes through air horn gasket.

2. Install two long air horn screws, five short screws and two countersunk screws in primary venturi area. Install air valve lockout guard under screw #4 in Fig. 6-75. Secure with self-tapping screw. To prevent binding of choke valve or air valve due to distortion of air horn, all screws must be tightened evenly, using the sequence shown in Fig. 6-75.

3. Connect accelerator pump rod in pump lever outer hole and retain with horseshoe clip.

4. Connect choke rod in lower choke lever and retain in upper lever with horseshoe clip.

NOTE: Be sure choke rod is located under lock-out tang before installing horseshoe clip.

5. Install vacuum break rod and horseshoe clip.

6. Attach secondary metering rods to hanger and screw hanger with rods to cam lever located between the two air valves.

7. Position idle speed up rod in tang and secure idle speed up diaphragm to throttle body with one screw.

OFF-CAR CARBURETOR ADJUSTMENTS

79. Float Adjustment (Fig. 6-76)

1. Remove air horn assembly as described in Note 70.

2. With adjustable T-scale, measure from top of float bowl gasket surface, with gasket removed, to top of float at toe, Fig. 6-76. Locate gage point 1/16" back from radius on toe.

3. Hold retaining pin firmly in place with tang of float lightly seated on float needle.

4. Scale dimension should be 15/64 (.240) inch on all except Eldorado. Scale dimension should be 11/32 (.350) inch on Eldorado only.

5. Bend float up or down to obtain proper measurement.

6. Install air horn assembly as described in Note 78.

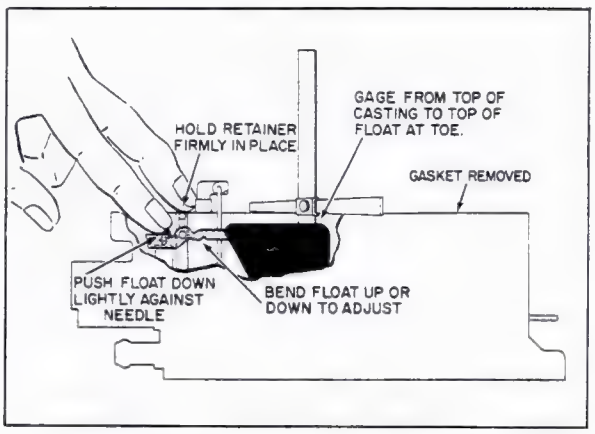


Fig. 6-76 Float Level Adjustment

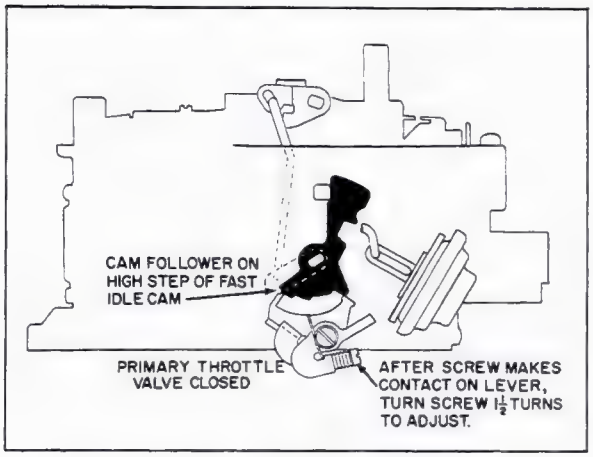


Fig. 6-77 Fast Idle Adjustment

80. Bench Fast Idle Adjustment (Fig. 6-77)

1. With primary throttle valves completely closed and cam follower over high step of fast idle cam, turn fast idle screw in one and one-half turns after screw makes contact on lever, Fig. 6-77.

81. Pump Rod Adjustment (Fig. 6-78)

1. With idle speed adjusting screw backed out of contact, throttle valves completely closed and pump rod in outer hole of pump lever, measure from top of choke valve wall, next to vent stack, to top of pump stem with adjustable T-scale.

2. Dimension should be 11/32 inch. Bend pump lever at the pump stem end, Fig. 6-78 to adjust.

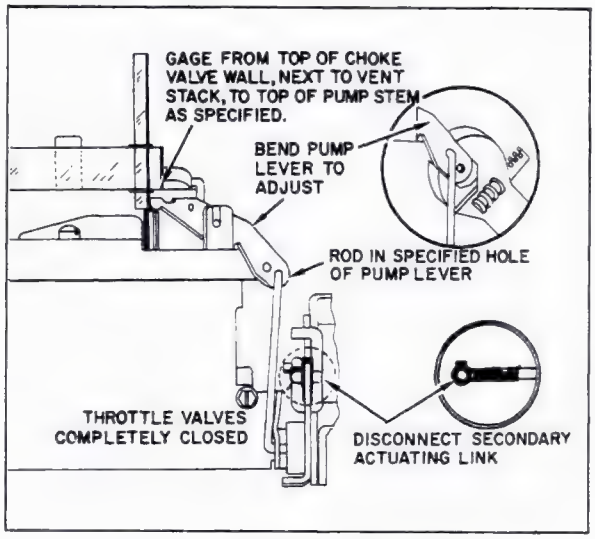


Fig. 6-78 Accelerator Pump Adjustment

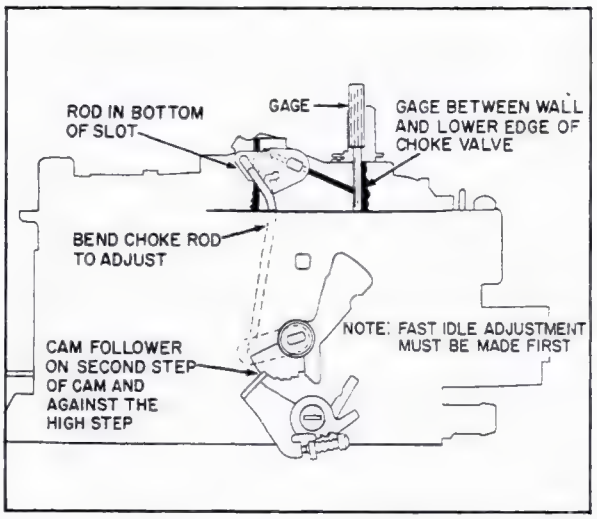


Fig. 6-79 Choke Rod Adjustment

82. Choke Rod Adjustment (Fig. 6-79)

1. Bench fast idle adjustment, Note 80, must be made before choke rod adjustment is made.

2. With fast idle adjustment made, cam follower on second step of fast idle cam and against high step of cam, rotate the choke valve toward the closed position by pushing up on vacuum break lever.

3. With choke rod at bottom of choke lever slot, dimension between lower edge of choke valve and air horn should be .090 inch.

4. Bend choke rod, Fig. 6-79 to adjust.

83. Air Valve Dashpot Adjustment (Fig. 6-80)

1. With air valve closed normally and vacuum

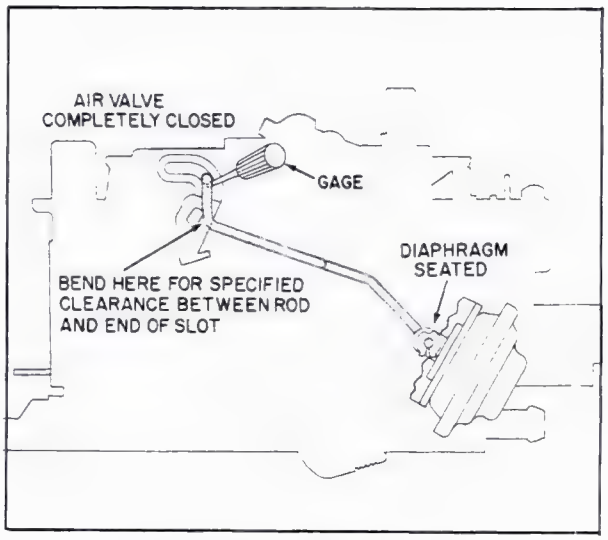


Fig. 6-80 Air Valve Adjustment

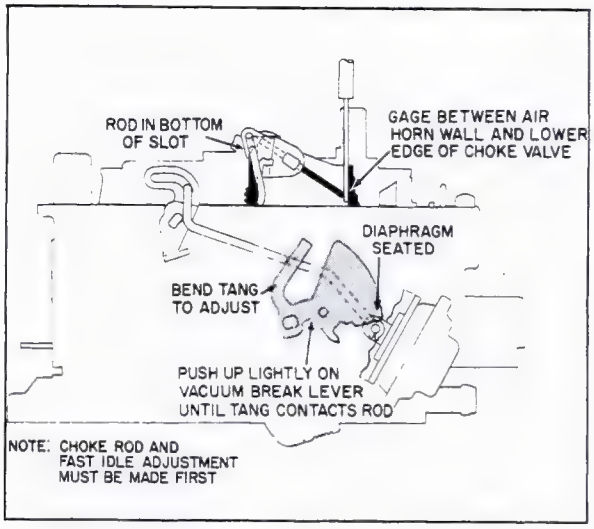


Fig. 6-81 Vacuum Break Adjustment

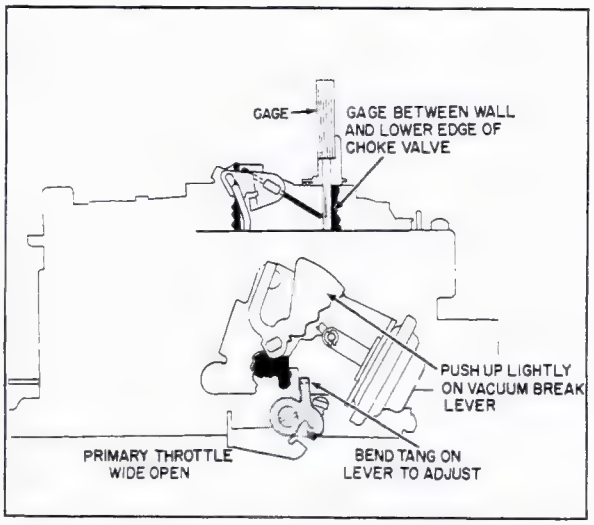


Fig. 6-82 Unloader Adjustment

break diaphragm seated, there must be clearance of .030 inch between dash pot rod and end of slot in air valve lever.

2. Bend rod at air valve end, Fig. 6-80, to adjust.

NOTE: The diaphragm may be seated by attaching a 3/16" I.D. rubber hose from the vacuum break diaphragm nipple, to any available external source supplying a vacuum of at least 6" hg. Oral vacuum will produce sufficient vacuum to seat the diaphragm.

84. Vacuum Break Adjustment (Fig. 6-81)

1. Bench fast idle adjustment Note 80, and choke rod adjustment, Note 82, must be made before this adjustment.

2. Open throttle valve and set fast idle cam on its highest step.

3. With vacuum break diaphragm stem against its seat and choke valve held toward the closed position, check dimension between lower edge of choke valve and air horn. Dimension should be .225".

4. Bend vacuum lever tang, Fig. 6-81, to adjust.

85. Unloader Adjustment (Fig. 6-82)

1. With choke valve held toward closed position by lifting up on vacuum break lever, open primary throttle to wide open position.

2. With valves in this position, take up linkage slack toward open position of valve. Dimension between lower edge of choke valve and air horn wall should be .312 inch.

3. Bend tang on fast idle adjusting lever, Fig. 6-82 to adjust.

86. Air Valve Lockout Adjustment (Fig. 6-83)

a. Opening Clearance

NOTE: Fast idle (off car) and choke rod adjustments must be made prior to this adjustment.

1. Remove two screws securing lockout guard to air horn and remove air valve lockout guard.

2. With choke valve wide open, apply sufficient downward force to the vacuum break lever to move choke rod to top of slot in choke lever.

3. Move air valve slightly in direction of open valve.

4. Bend upper end of air valve lockout lever tang, Fig. 6-83, if necessary, to give an opening of .015 inch between lockout tank and front edge of air valve.

5. Install air valve lockout guard and secure with two screws.

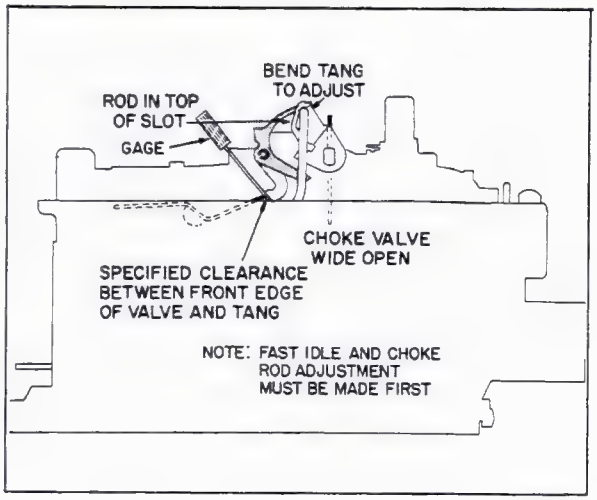


Fig. 6-83 Air Valve Lockout Adjustment

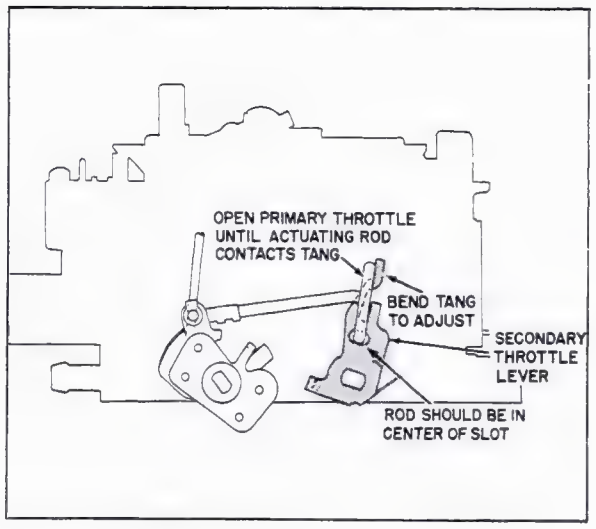


Fig. 6-84 Secondary Throttle Adjustment

b. Lockout

1. With the opening clearance adjustments made, open choke valve to its wide open position by applying force to "up" side of choke valve.

2. Open throttle slightly and set fast idle adjusting lever on highest step of fast idle cam. Making sure choke rod is in bottom of slot, by applying upward force to vacuum break lever, air valve lockout tang should allow only 8°-10° of air valve opening. During choke-on conditions, (warm-up), the air valve will open only 8°-10° even if throttle is wide open. This angle is not adjustable but is built into the assembly.

87. Secondary Throttle Opening Adjustment (Fig. 6-84)

1. Open primary throttle valves until actuating rod contacts tang on secondary throttle lever. With valves in this position, bottom of rod should be in center of secondary throttle lever slot.

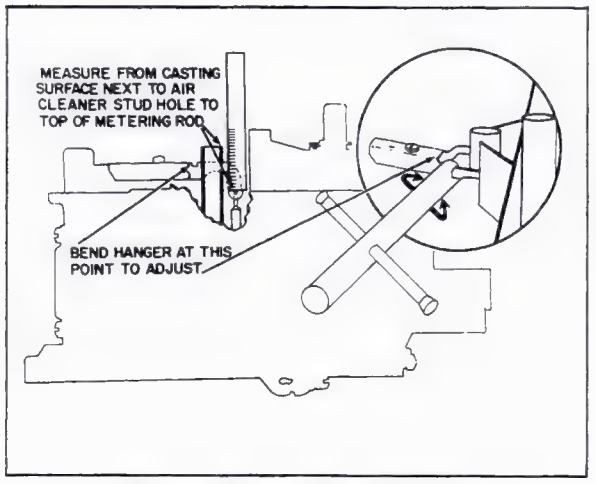


Fig. 6-85 Secondary Metering Rod Adjustment

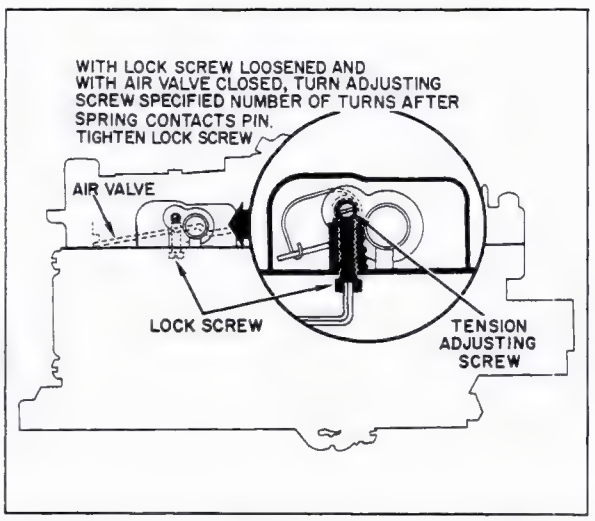


Fig. 6-86 Air Valve Spring Wind-Up Adjustment

2. Bend tang on secondary throttle lever, Fig. 6-84, if necessary to adjust.

88. Secondary Metering Rod Adjustment (Fig. 6-85)

NOTE: The metering rod hanger is not adjustable. Hangers are selectively matched to each carburetor and letter stamped. Unless the hanger has been damaged no change in hanger setting is necessary. If the hanger has been damaged, an adjustable hanger must be obtained from your servicing Parts Distribution Center and adjusted as described in this note.

1. To check secondary metering rod adjustment, measure from top of metering rod to top of air horn casting next to air cleaner stud hole, as shown in Fig. 6-85. This dimension should be .840 or approximately 27/32 for all carburetors.

CAUTION: Be sure to measure metering rod at the point where it enters the hanger. Do not use the bent portion of the rod for this measurement.

NOTE: Air valve must be closed when measurement is taken.

2. If adjustment is necessary, bend metering rod hanger with pliers at point shown in Fig. 6-85. Make sure both rods are adjusted to same dimension.

89. Air Valve Spring Wind-Up Adjustment (Fig. 6-86)

1. Loosen allen socket head lockscrew, Fig. 6-86, and turn adjusting screw counterclockwise to remove all spring tension.

2. With air valve closed, turn adjusting screw clockwise 1/2 turn after torsion spring contacts

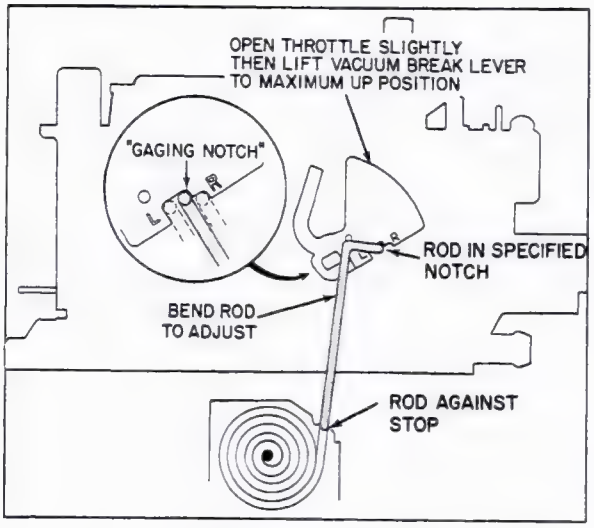


Fig. 6-87 Choke Coil Rod Adjustment

pin on shaft. Holding adjusting screw in this position, tighten lockscrew.

90. Choke-Coil Rod Adjustment (On Car) (Fig. 6-87)

1. Remove choke-coil assembly from manifold to disengage choke coil rod from vacuum break lever.

2. Reinstall choke coil assembly but do not install choke coil rod into hole in vacuum break lever.

3. With choke valve completely closed, fast idle cam in cold start position and vacuum break lever in maximum upward position, pull choke coil rod upward to end of travel against stop in choke coil housing. Upper end of rod should be positioned in gaging notch as shown in Fig. 6-87.

4. Bend choke-coil rod to adjust for position in proper gaging-notch.

5. Remove choke coil assembly from manifold. Reinstall by putting upper end of choke coil rod into hole in vacuum break lever and tighten coil assembly to manifold.

NOTE: The "L" gauging notch is for a one notch leaner setting and the "R" gauging notch is for a one notch richer setting.

91. Low Speed Idle and Mixture Adjustment (On Car) (Fig. 6-88)

NOTE: Before Low Speed Idle and Mixture Adjustment is made with engine running, Distributor Vacuum Advance Hose must be disconnected and plugged at the distributor to eliminate the possibility of advancing the timing and increasing engine rpm.

If stainless steel shim is not installed, engine will not idle, see Note 69b.

1. Disconnect parking brake vacuum hose at vacuum release cylinder and plug hose.

Fig. 6-88 Adjusting Low Speed Idle

NOTE: Hose must be disconnected at this location to include any calibrated leakage in balance of system.

2. Connect tachometer to engine and set parking brake securely. Place transmission selector lever in Neutral.

3. Remove air cleaner. Be sure that throttle dash pot is not holding throttle valves open.

4. For preliminary adjustment, turn idle speed adjusting screw in approximately 1-1/2 turns after screw contacts primary throttle lever. Mixture screws should be out approximately 4 turns. Start and warm engine to normal operating temperature. Be sure that choke is fully off and that carburetor is on slow idle with primary and secondary throttle valves closed.

5. Place transmission selector lever in either "DR" position and turn A/C off.

6. Hot idle compensator must be closed when idle adjustments are made. This can be done by pressing finger or eraser end of pencil on compensator pin located just in front of the primary throttle bores.

7. Set idle speed to 550 rpm by adjusting low speed idle screw shown in Fig. 6-88.

8. Using Extension Hex-head Driver, J-22646, turn one idle mixture adjustment screw clockwise in order to obtain highest reading on tachometer.

9. Continue to turn screw until speed falls off 20 rpm. This point is lean idle speed fall off.

10. Reverse screw one turn from 20 rpm lean idle speed fall off.

11. Repeat steps 8 through 10 with other idle mixture adjusting screw.

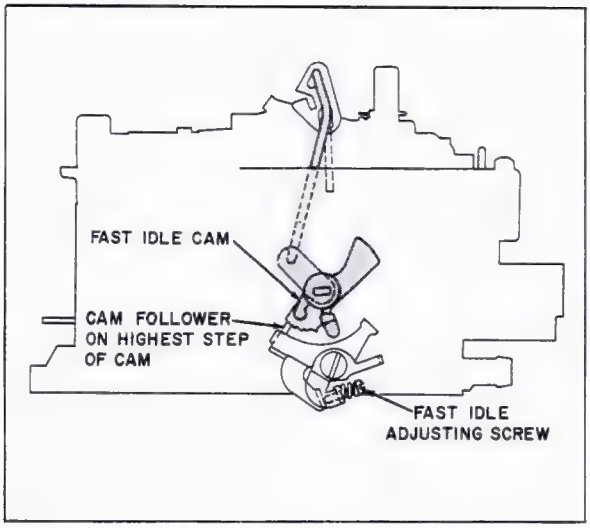


Fig. 6-89 Fast Idle Adjustment

12. Repeat steps 7 through 11 until an idle speed of 550 rpm is reached.

13. Install air cleaner and recheck idle. If idle speed is not within specifications, repeat procedure outlined in steps 7 through 12.

14. Shut off engine and remove tachometer.

15. Connect parking brake vacuum cylinder line.

16. Connect distributor vacuum line.

92. Fast Idle Adjustment (On Car) (Fig. 6-89)

NOTE: Preceding idle adjustments must be made first. Automatic Climate Control should be in "Off" position on cars so equipped.

1. Start engine and allow engine and transmission to reach operating temperature; choke should be fully open. Be sure parking brake is applied.

2. Shut off engine and remove air cleaner.

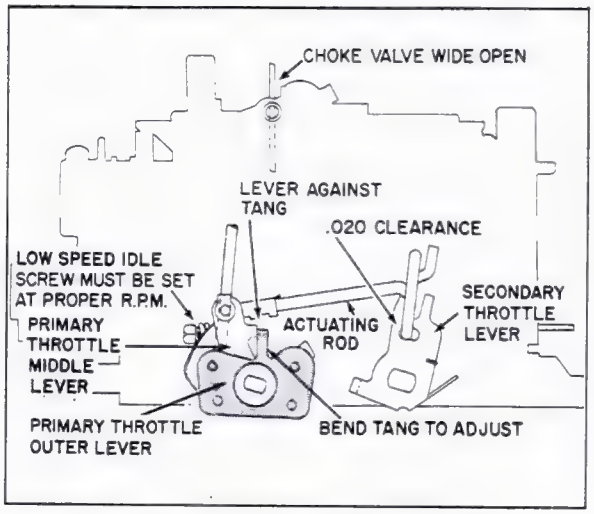


Fig. 6-90 Secondary Throttle Adjustment

3. Open throttle slightly. Set fast idle cam follower on highest step of cam, Fig. 6-89.

4. Start engine. Choke valve will be open because engine is fully warmed up.

5. Observe idle speed and adjust fast idle screw, Fig. 6-89, to give 1900-1950 rpm with transmission in Neutral. Return engine to normal idle and install air cleaner.

93. Secondary Throttle Closing Adjustment (On Car) (Fig. 6-90)

1. Set curb idle screw to recommended rpm, as described in Note 91, making sure cam follower is not resting on fast idle cam.

2. There should be .020 clearance between actuating rod and front of slot in secondary throttle lever as shown in Fig. 6-90, when primary throttle middle lever is against tang of primary throttle outer lever.

3. If adjustment is correct, replace air cleaner.

4. If adjustment is necessary, remove transmission downshift switch by removing two screws from the dash pot bracket.

NOTE: Secondary throttle opening adjustment (Note 87) must be made before attempting this adjustment.

5. Disconnect throttle return spring(s) and throttle rod or cable at throttle adapter plate.

6. Remove cross head recess screws holding throttle adapter plate to primary throttle outer lever, and remove throttle adapter plate.

7. Bend tang of primary throttle outer lever as necessary to adjust.

8. Attach throttle adapter place to primary throttle outer lever.

9. Connect throttle return spring(s) and throttle rod or cable at throttle adapter plate.

10. Install transmission downshift switch assembly and adjust as described in Notes 96 and 97.

11. Install air cleaner.

94. Throttle Rod Adjustment (Except Eldorado)

1. Remove air cleaner.

2. Check linkage for free movement in all positions, and check to see that return spring fully closes the throttle.

3. Remove cotter pin that holds end of throttle rod in relay lever, and remove washers and end of rod from relay lever.

4. On cars equipped with Cruise Control, detach Cruise Control linkage at Cruise Control power unit end.

5. While a helper presses accelerator pedal against floor mat, hold carburetor throttle lever in full throttle (wide open) position. Make sure choke valve is wipe open.

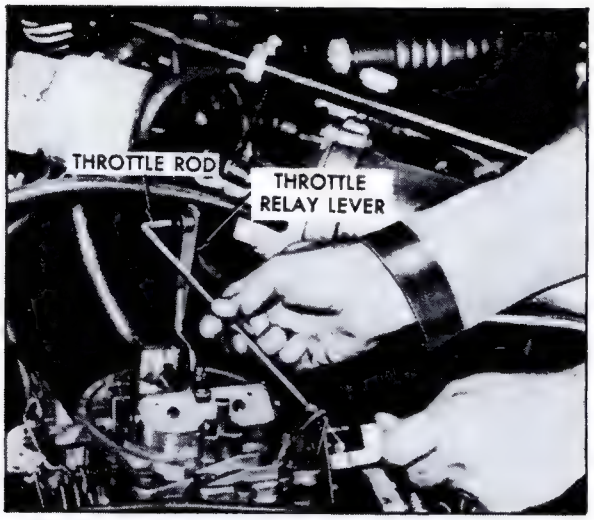


Fig. 6-91 Throttle Rod Adjustment - Except 693

6. Loosen lock nut and turn throttle rod end in either direction as necessary to allow free entry into bushing on relay lever, Fig. 6-91.

7. With accelerator pedal released, reinstall washer on throttle rod and install rod into bushing in relay lever.

8. Install other washer and then install cotter pin. Recheck for fully closed throttle. With accelerator pedal pressed again to floor mat, recheck throttle for wide open position.

9. On cars equipped with Cruise Control, install Cruise Control linkage. If adjustment on throttle rod was changed, it will be necessary to adjust Cruise Control linkage as outlined in Section 15, Note 19.

95. Throttle Rod Adjustment (693 Eldorado)

1. Remove air cleaner.

2. Check cable linkage for free movement in all positions, and check to see that return spring fully closes throttle.

3. Disconnect cable rod retaining clip at throttle adapter plate and remove cable rod from adapter plate.

4. While a helper presses accelerator pedal against floor mat, hold carburetor throttle lever in full throttle (wide open) position. Make sure choke valve is wide open.

5. If cable rod fitting does not line up exactly with its connecting pin on throttle adapter plate, loosen two nuts at cable mounting plate on left rear of carburetor, and position cable backward or forward to allow exact alignment into throttle adapter plate hole, Fig. 6-92.

6. Tighten cable mounting screws on mounting plate.

7. With accelerator again pressed to floor mat, recheck throttle for wide open position. Recheck for fully closed throttle.

8. Replace air cleaner.

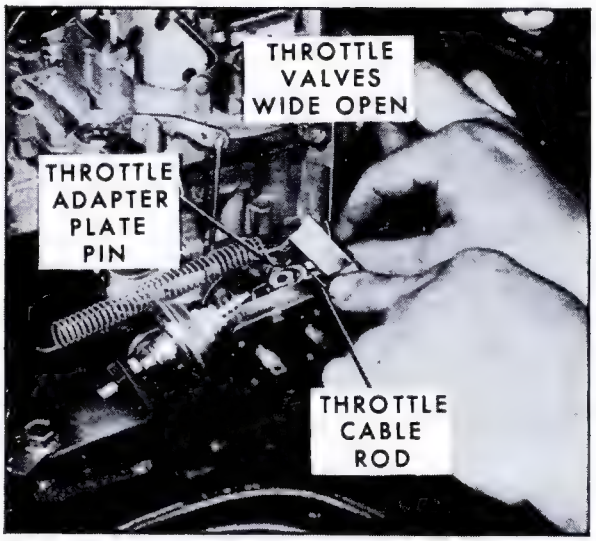


Fig. 6-92 Throttle Rod Adjustment - 693 Only

96. Transmission Downshift Switch Removal and Installation

a. Removal

1. Remove air cleaner.

2. Disconnect wire connectors.

3. Remove two screws from dash pot mounting bracket.

4. Remove downshift switch.

NOTE: Transmission downshift switch can be removed with throttle dash pot as an assembly by removing two screws at bracket under ignition coil mounts.

5. Remove spring and lever from downshift switch shaft.

b. Installation

NOTE: If downshift switch was removed along with throttle dash pot mounting bracket as an assembly, install bracket after positioning actuating shaft as described in Step 1 and secure bracket under coil mount with two screws and washers.

1. Install spring on downshift switch shaft with hooked end under bracket.

2. Hold switch in on-car position and rotate switch actuating shaft clockwise until it stops. Install lever on shaft with notch on inside and lever in straight-up position.

3. Locate open end of spring behind notch in lever and wind spring one turn around shaft. Fasten by positioning hooked end behind bracket.

4. Insert shaft into hole on throttle adapter plate.

5. Insert two mounting screws through switch mounting to throttle dash pot mounting bracket and lightly tighten.

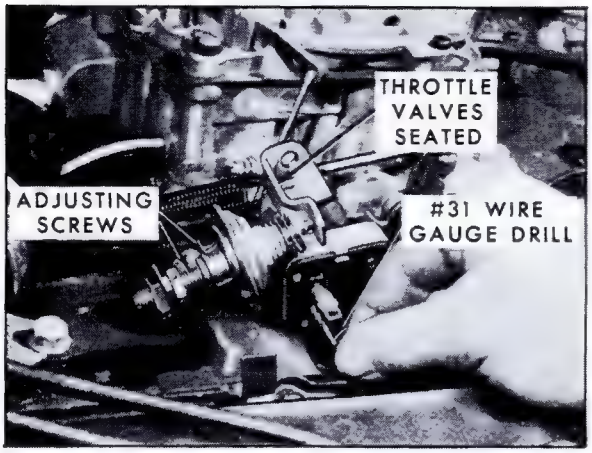


Fig. 6-93 Downshift Switch Adjustment

6. Adjust switch as described in Note 97.
7. Connect wires to terminals on switch.
8. Replace air cleaner.

97. Transmission Downshift Switch Adjustment

1. Remove carburetor air cleaner.
2. Make certain that carburetor is adjusted to specification and that throttle linkage is at low speed idle setting.
3. Loosen two mounting screws and insert a #31 (.120") wire gage size drill through the calibrating hole below lower wire terminal extending through to carburetor side of switch, Fig. 6-93. Adjust position of switch so that lever just touches the carburetor adapter plate arm (stud on 693).

With this adjustment the downshift switch should make contact above 60° throttle.

4. With switch positioned, tighten mounting screws and remove #31 (.120") gage from calibrating hold through switch.
5. Repeat step 3, if necessary.
6. Install air cleaner.

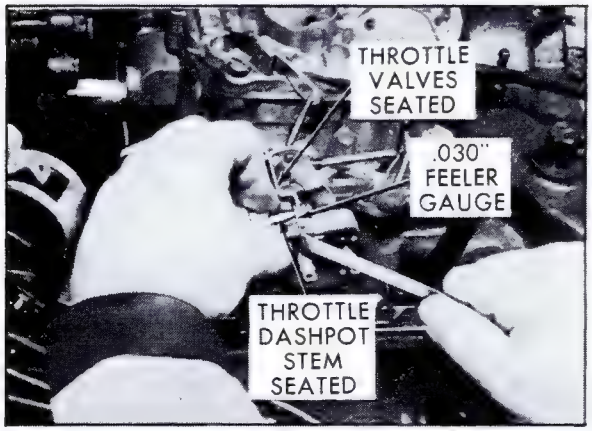


Fig. 6-94 Throttle Dashpot Adjustment

98. Throttle Dash Pot Assembly

a. Removal

1. Remove air cleaner for greater accessibility.
2. Loosen locknut securing dash pot shaft to bracket, Fig. 6-94 and unscrew dash pot from weld nut on bracket.

NOTE: Throttle dash pot assembly can also be removed along with its mounting bracket by removing two screws and washers at base of bracket under ignition coil mounts.

3. Remove dash pot assembly from engine.

b. Installation

1. Install dash pot shaft with locknut into weld nut on mounting bracket, and secure with locknut, Fig. 6-94.

NOTE: If throttle dash pot was removed along with its mounting bracket, install dash pot and mounting bracket by positioning bracket under coil mounts and securing with two screws and washers.

2. Install air cleaner.
3. Adjust dash pot as outlined in Part C. If bracket was removed, check transmission downshift switch adjustment also.

c. Adjustment

NOTE: Low speed idle and mixture adjustment, Note 91, must be made before adjusting dashpot.

1. Remove carburetor air cleaner.

NOTE: Be sure throttle is not resting on fast idle cam.

2. Hold dash pot stem completely into dash pot and insert a .030" feeler gage between dash pot stem and throttle adapter plate, Fig. 6-94. If clearance is greater or less than .030", proceed to step 3.
3. Back off locknut holding dash pot to bracket and adjust dash pot fore or aft until dash pot clearance is exactly .030".
4. Tighten locknut ot lock dash pot to bracket.
5. Install air cleaner.
6. Start and warm up engine to operating temperature and make certain fast idle screw is released from fast idle cam.
7. Apply foot brake firmly with left foot and place selector lever in Drive. On air conditioned cars, make sure the system is in operation. Depress accelerator pedal and release rapidly.

NOTE: Do not depress accelerator pedal repeatedly, or transmission may become overheated.

8. If engine stalls, clearance is too great. Place selector lever in Neutral, loosen locknut on dash pot and turn dash pot counterclockwise two flats. Tighten locknut and repeat step 7.
9. Road test car.

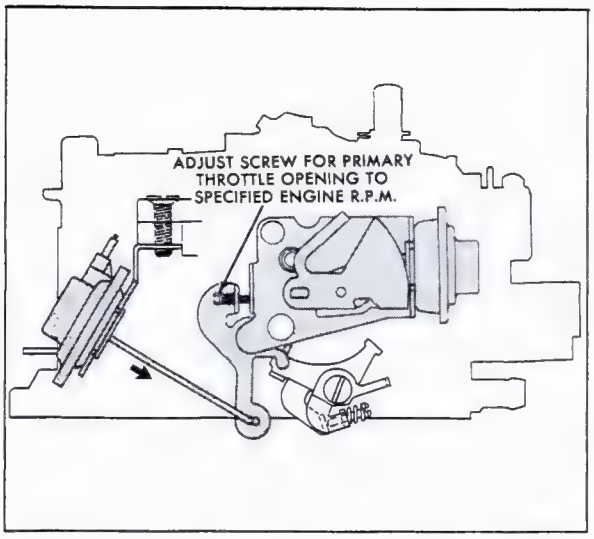


Fig. 6-95 Idle Speed Up Device Adjustment

99. Idle Speed-Up Control Adjustment (On Car)

Unlike previous years, when the idle speed up was actuated through the air conditioning system whenever the car was in park or neutral, the 1969 unit works only when radiator temperature reaches 220°F. Air conditioning does not have to be on to have idle speed up; idle speed up is a function of water temperature.

To set the idle speed-up to the recommended 900-950 rpm, the following procedure should be followed:

1. Curb and fast idle adjustments (Notes 91 and 92) should be done before attempting the idle speed-up adjustment.

2. With engine off, remove air cleaner.

3. Disconnect vacuum hose leading from thermo vacuum switch to reducing nipple near dash, at the reducing nipple.

4. Disconnect vacuum hose at diverter valve and connect to reducing nipple.

5. Disconnect distributor vacuum hose at vacuum unit and plug end of hose.

6. Disconnect manifold vacuum hose from thermo vacuum switch nipple marked "MT" and connect to distributor vacuum advance unit. This is the most rearward nipple in the switch (closest to block).

7. Turn AC on to HIGH position and turn temperature dial to 65.

8. Start engine (engine should be warmed up) and make idle speed-up adjustment with transmission in park or neutral and emergency brake on.

9. Turning adjusting screw on idle speed-up control arm, Fig. 6-95, to maintain an idle speed of 900-950 rpm.

10. Turn engine off, reconnect hoses and install air cleaner.

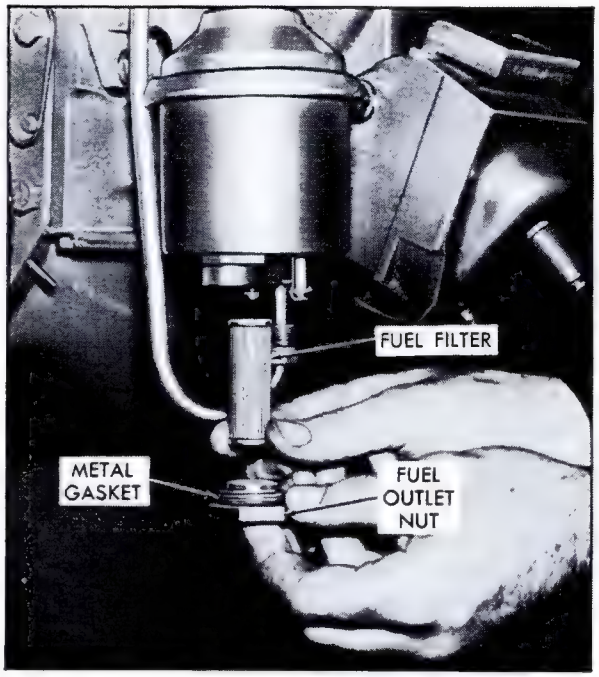


Fig. 6-96 Installing Fuel Filter

100. Fuel Filter

a. Removal

1. Raise car and clamp the rubber section of the inlet hose to prevent siphoning gas from the tank.

2. Disconnect fuel pump outlet line at fuel pump. Use two wrenches, one to hold large nut while disconnecting the tubing nut with the other wrench.

3. Using two wrenches, one to keep from twisting and loosening nut welded to pump cover, the other wrench to loosen and remove outlet fitting which retains the filter.

4. Remove the filter and discard. Use care when removing the nut to avoid damaging the metal gasket. Be careful that the spring surrounding and seating the filter does not fall out of the pump.

b. Installation

1. Position new filter into nut and screw nut into pump. Filter should be installed with the open end seated inside the nut. The metal gasket may be re-used if it is not damaged.

2. Using two wrenches, tighten outlet fitting to pump.

3. Using two wrenches again, tighten fuel line to outlet fitting. Remove clamp from hose.

4. Wipe all gasoline that may have spilled and ventilate area before starting engine.

5. Start engine and check for leaks; correct leaks as necessary.

101. Fuel Pump Tests

1. To check fuel pump capacity, raise car and disconnect fuel inlet hose at the pump and plug. On cars with A/C clamp off vapor return line; do not remove from pump (Use towel to absorb slight gas drainage.)

2. Connect about 2 feet of flexible gasoline hose (5/16 I.D.) to the fuel pump inlet nipple.

3. Lower car and insert end of flexible hose into gallon container with 1/2 gallon of kerosene, wash gas or similar solvent (not gasoline). Rest container on floor below the fuel pump. Be sure end of hose does not rest against bottom of container.

4. Disconnect fuel line at carburetor and slip over the flared end of the pipe about two feet of flexible gasoline hose (5/16 I.D.).

5. Connect a jumper wire from the negative coil primary terminal to a good ground so that the engine will not start when cranked.

6. Crank engine to prime pump until approximately 1/2 pint of liquid has been pumped and all gasoline purged from the pump before checking output.

7. Seventeen strokes should fill a pint container. If liquid is delivered as specified, pump delivery is normal. If pump delivery is below normal, check for the following possible conditions:

a. Liquid leaking out of pump at fittings or joints. This should be obvious if gasoline has leaked, by the absence of paint on the pump or a clean spot on the engine or frame.

b. Plugged filter in pump. Replace and recheck.

c. Worn eccentric or arm. Remove pump as described in Note 102 and visually check fuel pump eccentric for wear using mirror and flashlight through mounting flange, inspect fuel pump arm for wear. A worn arm generally indicates a worn eccentric.

NOTE: If fuel pump check shows delivery is adequate but car did not perform satisfactorily, check for pinched, damaged, or leaky fuel inlet line and hoses back to the tank and discharge line to carburetor and the vapor return line. Check for a plugged filter in the gas tank. Replace damaged or defective parts.

8. If pump does not operate properly after these checks have been made, replace pump.

NOTE: By following the procedure given below, the displacement capacity of the pump can be increased by as much as 5 c.c. per stroke.

9. When installing pump, crank engine until fuel pump eccentric is at its low point of contact with the fuel pump arm. With mounting screw and nut loose, lift up on pump. At the same time, tighten nut to 15 foot pounds.

10. To check pump discharge pressure, remove hose from carburetor end of fuel line and connect pressure gauge using suitable fittings. At cranking speed, fuel pump pressure should be a minimum of 5 pounds per square inch.

If pump pressure is out-of-specification, replace pump.

11. Remove pressure gauge and connect rubber hose previously used. Remove hose from checking solution and crank engine over, collecting discharged liquid in suitable container until all liquid is pumped out of system.

12. Remove hose from carburetor end of fuel line and reconnect fuel line to carburetor securely using tubing wrench. Be sure carburetor inlet nut is tight. Be careful not to disconnect any vacuum hoses or tees at the carburetor.

13. Remove coil jumper wire.

14. Raise car and remove rubber hose from inlet side of pump and re-connect flexible hose attached to fuel line.

15. Unclamp vapor return line.

16. Lower car, start engine and check for fuel leaks.

102. Fuel Pump

a. Removal

1. Raise car.

2. Disconnect fuel line from tank (fuel pump inlet) at fuel pump and plug line. Hold a cloth around pump connections to absorb any fuel that leaks out.

3. Remove vapor return hose from fitting on fuel pump and plug hose.

4. Disconnect fuel-pump-to-carburetor line (fuel pump outlet) and position out of way.

5. Remove mounting screw from upper pump flange.

6. Remove nut from mounting stud at lower pump flange.

7. Tipping pump upward, pull pump straight outward and remove from car.

b. Installation

1. Clean mounting flange and place a new gasket in position.

2. Position pump on engine with slot on lower flange over stud on engine.

3. Secure pump to engine with nut and washer on stud at lower flange and screw through upper flange. Tighten both to 15 foot-pounds.

4. Connect fuel line from carburetor to outlet fitting on pump and tighten securely.

5. Unplug fuel line from fuel tank, attach line to pump inlet and secure with clamp.

6. Install vapor return hose on fitting in fuel pump and secure with clamp.

7. Lower car and run engine to check for leaks in the pump area.

EMISSION CONTROL SYSTEMS

Crankcase Ventilation System (Fig. 6-97)

The crankcase ventilation system on all 1969 Cadillac engines is designed to prevent contaminating hydrocarbons from escaping to the atmosphere. This is accomplished by routing the vapors from the crankcase through a vacuum controlled ventilating valve on the right rocker arm cover into the intake manifold, where they mix with the air-fuel mixture and are burned in the combustion process.

Air is supplied to the crankcase ventilation system through a crankcase ventilating breather assembly located between the air cleaner and the left rocker arm cover.

The two critical points in this system are the ventilator (PCV) valve, which should be changed every 12,000 miles or 12 months, whichever occurs first, and the crankcase ventilating breather located on the left rocker arm cover, which should be cleaned every 6,000 miles or four months, whichever occurs first. Other components of the system should be inspected, cleaned and/or replaced as necessary every 12,000 miles or 12 months, whichever occurs first.

When the engine is operating, air enters the positive crankcase ventilation system through the air cleaner and breather located on the left rocker arm cover. The breather contains a hog's hair element. The air then flows into the left rocker arm cover and into the valve lifter compartment, and combines with the blow-by gas, and unburned air-fuel mixture. These fumes are then drawn through the right rocker arm cover and ventilator valve into the base of the carburetor and intake manifold where they are mixed with the air-fuel mixture and burned.

The ventilator valve, Fig. 6-98, is constructed so that it is held closed by spring pressure when the engine is not running. This prevents an accumulation of hydrocarbon laden fumes from collecting in the intake manifold, which could result in hard starting.

As the engine is started, manifold vacuum pulls the valve open against the spring pressure and, as long as there is engine vacuum, the valve floats, permitting crankcase fumes to enter the intake manifold. A baffle in the right rocker arm cover prevents oil from being drawn into the intake manifold through the ventilator valve.

In the event of an engine backfire through the

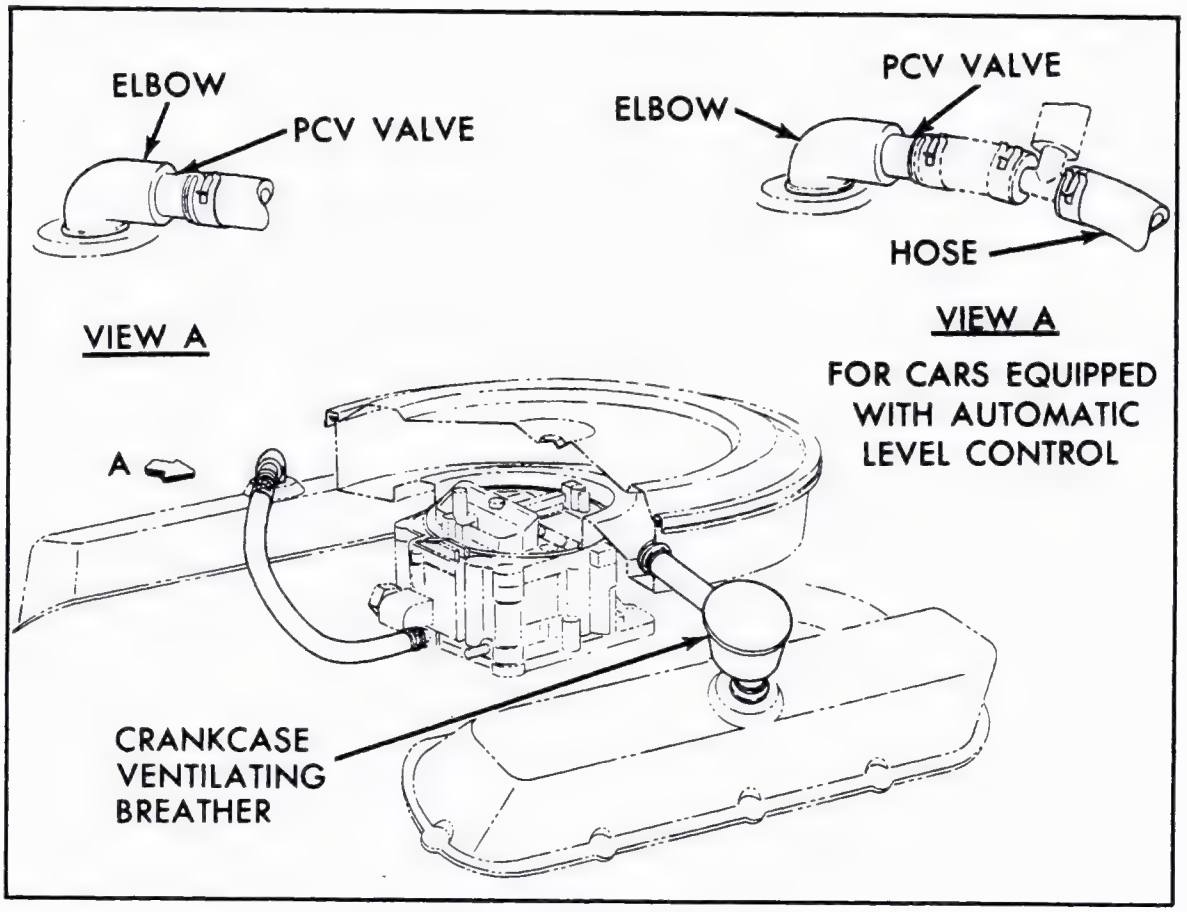


Fig. 6-97 Crankcase Ventilating System

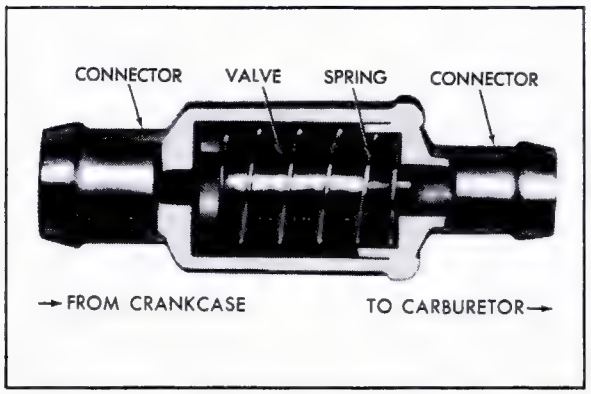


Fig. 6-98 PCV Valve

intake manifold the ventilator valve shuts, preventing any flow through it. This action prevents the ignition of fumes in the crankcase that could cause a crankcase fire or explosion.

During certain engine operations where more blow-by is created than the ventilator valve can handle, the excess amount is returned to the air cleaner and to the carburetor by way of the left rocker arm cover and breather assembly and burned in the engine, instead of being released into the atmosphere. The breather assembly acts as a separator to keep oil from being drawn up through the air cleaner during this operation.

Air Injection Reactor (A.I.R)

The A.I.R. system is installed on all 1969 Cadillac cars. The Cadillac A.I.R. system reduces the amount of hydrocarbons and carbon monoxide in the exhaust gases by injecting air directly into the exhaust port of each cylinder. The air added to the hot exhaust gases causes further oxidation of the gases before they enter the exhaust pipe.

The A.I.R. system consists of a belt-driven pump located with the front accessory group, a formed rubber air hose, a metal tubing manifold between the cylinder heads, and specially designed cylinder heads that incorporate air passages to the rear of each exhaust valve. There is a diverter valve and silencer on the A.I.R. pump to control pressures within the system, and a check valve to protect the hoses and pump from hot gases.

Do not attempt to operate vehicle with drive belt disconnected.

a. Air Pump (Fig. 6-100)

The belt-driven air pump is located at the lower right front of the engine. The pump front mounting

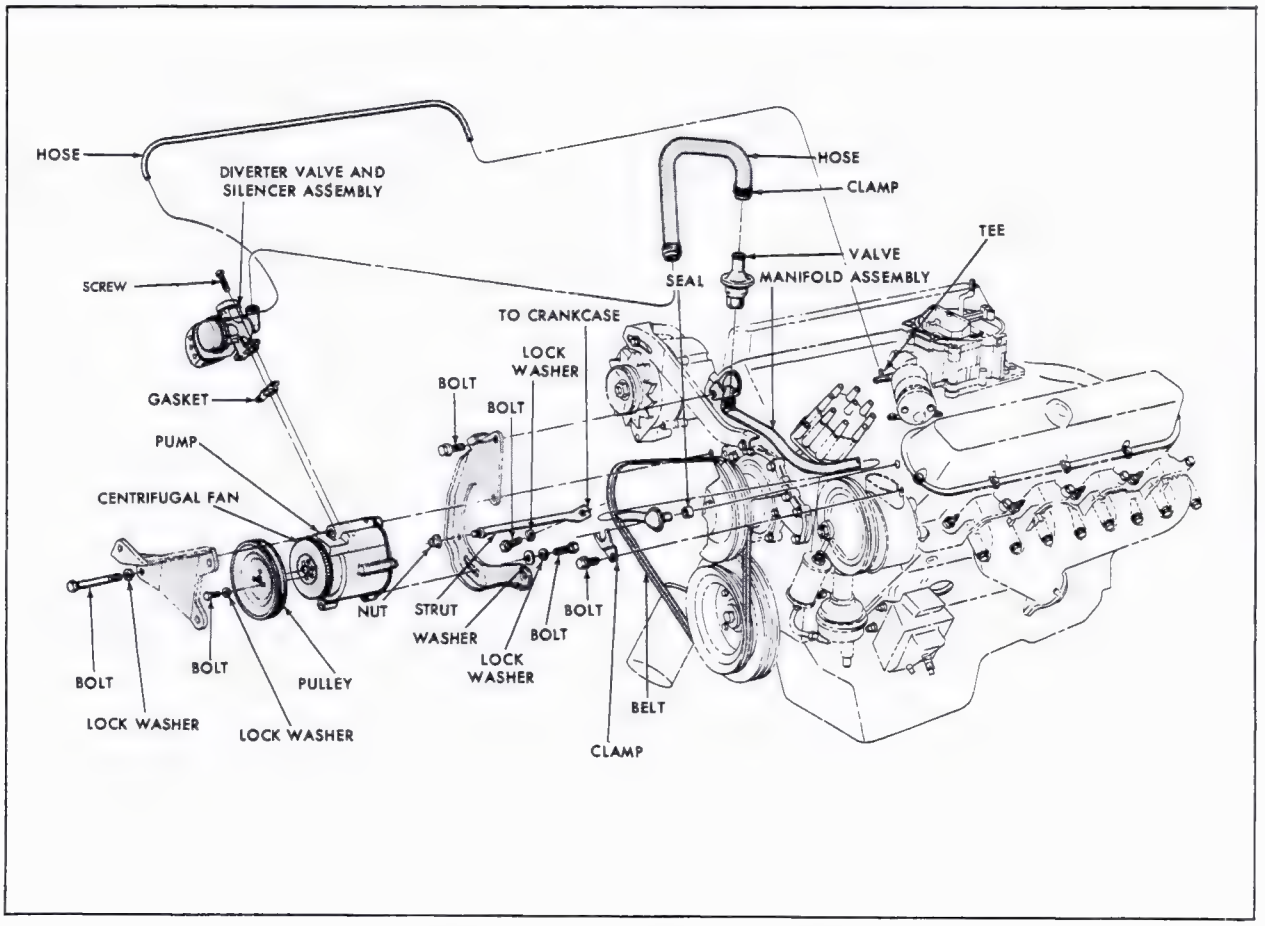


Fig. 6-99 Air Injection Reactor System

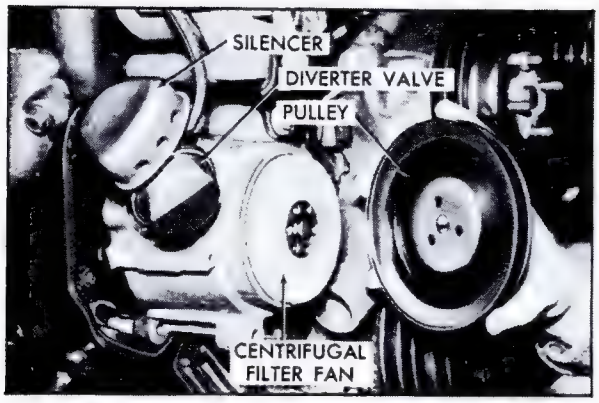


Fig. 6-100 A.I.R. Pump

bracket is attached to the front of the engine. The pump rear mounting bracket is attached to the cylinder block. Power take-off for the pump is at the crankshaft pulley. Pump speed is 1.20 times crankshaft speed. Intake air passes through a centrifugal fan at the front of the pump, where foreign materials are separated from the air by centrifugal force. Air is delivered to the air injection manifold by a formed flexible hose of three-quarter inch inside diameter fitted to a three-quarter inch exhaust tube on the diverter valve at the side of the pump. hoses are secured to all fittings by clamps.

The only serviceable component of this pump is the centrifugal fan. Do no assume pump is defective if it squeaks when turned by hand. Do not lubricate the pump in any way.

NOTE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump.

b. Air Injection Manifold

The air injection manifold is held in the cylinder heads by clamps. These clamps must be installed correctly to insure proper sealing. The right hand side clip, (generator side) should be installed with the flanges pointing towards the cylinder head. The left hand clip should be installed with the flange pointing away fom the cylinder head. Each feeder tube of the manifold is sealed by an asbestos and graphite packing gland which fits on the tube below the flange.

c. Cylinder Heads

Each cylinder head contains an air passage inboard of the valves with connecting passages at each exhaust valve area. The passages lead into the exhaust passages directly behind the valves. Main air passages at the front of each cylinder head are counter-bored and chamfered to provide a seat for the feeder tube packing gland. The glands bottom on the chamfered counter-bore shoulders.

d. Carburetor

The A.I.R. system requires a specially calibrated Quadrajet 4MV carburetor. The idle mixture screws have an extra long needle taper (except Eldorado) to provide finer mixture adjustment.

e. Diverter Valve (Fig. 6-100)

The diverter valve is attached to the side of the pump. It senses manifold vacuum through a three-sixteenths inch fitting at the carburetor. During sudden deceleration, vacuum increases causes the valve to open, allowing air from the air injection pump to pass through the valve and silencer to the atmosphere. Approximate duration of the valve opening is four seconds. This valve also controls pressure within the system by diverting excessive pump output to the atmosphere through the silencer.

f. Check Valve

The air injection manifold is fitted with a screw-on check valve near the right cylinder head. This valve has a one-way diaphragm which prevents hot exhaust gases from backing up into the hose and pump and causing damage. This will protect the system in the event of pump belt failure, abnormally high exhaust system pressure, or air delivery hose ruptures.

103. Crankcase Ventilating Breather Assembly (Fig. 6-97)

a. Removal

1. Pull pipe and breather assembly from grommet on side of air cleaner.
2. Remove breather from grommet on left rocker arm cover.

b. Installation

1. Insert breather into grommet in left rocker arm cover.
2. Insert breather and pipe into grommet in air cleaner.

104. Postive Crankcase Ventilator Valve Replacement (Fig. 6-98)

a. Removal

1. Disconnect valve from rubber elbow on right rocker arm cover.
2. Release hose clamp and hose from ventilator valve grommet.

b. Installation

1. Place a small amount of silicone on both ends of new ventilator valve.
2. Install new valve with smaller end into hose.
3. Secure hose to valve with clamp.
4. Install larger end of ventilator valve to right rocker arm cover grommet.

CRANKCASE VENTILATOR VALVE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE
Slow, unstable idle, rolling, frequent stalling, breather backflow.	Valve completely plugged, or stuck in backfire (engine off) position.
Engine operation OK, but breather backflow at heavy throttle.	Valve stuck in idle position.
Rough, fast idle. Engine stalls. No backflow.	Valve stuck in intermediate position.

NOTE: If the valve is inoperative, it should be replaced.

105. Check Valve

a. Removal

1. Release clamp and disconnect air hose from check valve.
2. Unscrew check valve from manifold fitting.

b. Installation

1. Screw check valve onto manifold fitting.
2. Position air hose on check valve and secure with clamp.

106. Silencer (Fig. 6-100)

The silencer is staked to the diverter valve and cannot be removed. If a damaged silencer is encountered, the diverter valve and silencer assembly must be replaced.

107. Diverter Valve and Silencer Assembly (Fig. 6-100)

a. Removal

1. Disconnect vacuum hose from diverter valve.
2. Release clamp and remove air hose from fitting on diverter valve.
3. Remove two screws securing diverter valve and silencer assembly to pump and remove diverter valve assembly.
4. Remove gasket material from diverter valve and pump flanges.

b. Installation

1. Position new gakset on pump flange.
2. Position diverter valve on pump flange and secure with two screws.
3. Connect air hose to diverter valve fitting and secure with clamp.
4. Connect vacuum hose to fitting on diverter valve.

108. Centrifugal Filter Fan (Fig. 6-100)

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

NOTE: Centrifugal fan should not be removed from pump unless it is damaged, as removal procedures will destroy impeller.

a. Removal

1. Remove pump drive belt.
2. Remove three screws and remove pump pulley, Fig. 6-100.
3. Break remaining portion of centrifugal fan off pump hub, being careful that fragments do not enter air intake hole.

b. Installation

1. Position new centrifugal fan on pump hub.
2. Position pump pulley against impeller.
3. Install three pulley screws and tighten equally to 60 inch-pounds. This will press centrifugal fan onto pump hub. Do not drive centrifugal fan on with hammer.

NOTE: The slight amount of interference with the housing bore is normal. After a new fan has been installed, it may squeal upon initial operation or until its O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.

4. Install pump drive belt.
5. Adjust drive belt tension as described in Note 11d.

109. A.I.R. Pump Removal and Installation

Servicing of this pump should be limited to replacement of the entire pump. Do not open pump for any reason. Do not use a hammer or pry bar on the pump housing or clamp it in a vise.

a. Removal

1. Raise car and place on jack stands.
2. Remove lower A.I.R. pump mounting screw.
3. Disconnect air hose from diverter valve on side of pump.
4. Disconnect vacuum line from fitting on diverter valve.
5. Loosen upper mounting screw.
6. Remove A.I.R. pump belt.
7. Loosen lower generator mounting bracket.

8. Remove upper mounting screw.
9. Shift pump forward and downward between oil filter and lower radiator hose.

b. Installation

1. Lift pump up through space between lower radiator hose and oil filter. Rotate pump so that diverter valve passes over oil filter.
2. Position pump against mounting bracket and loosely install upper screw. The original mounting bolts or exact duplicates should be used at all times.
3. Loosely install lower screw.
4. Install drive belt on pump and adjust belt as described in Note 11.
5. Connect air hose to large fitting of diverter valve with clamp.
6. Install vacuum hose on small fitting of diverter valve.
7. Adjust generator belt tension as described in Note 9b.
8. Tighten generator mounting bracket.
9. Tighten both A.I.R. pump screws to 25 foot-pounds.

A.I.R. PUMP DIAGNOSIS CHART

CONDITION	CAUSE	CORRECTION
Excessive Belt Noise	Loose belt.	Tighten belt.
	Seized pump.	Replace pump.
Excessive Pump Noise, Chirping, Rumbling or Knocking	Leak in hose.	Locate source of leak and correct.
	Loose hose.	Reassemble and replace or tighten hose clamp.
	Hose touching other engine parts.	Adjust hose position.
	Diverter valve failure.	Replace valve.
	Check valve failure.	Replace valve.
	Pump mounting fasteners loose.	Retorque all mounting screws.
	Impeller damaged.	Replace impeller.
	Pump failure.	Replace pump.
No air supply.	Loose belt.	Tighten belt.
	Leak in hose.	Locate source of leak and correct.
	Leak at hose fitting.	Reassembly and replace or tighten hose clamps.
	Diverter valve failure.	Replace valve.
	Check valve failure.	Replace valve.
	Pump failure.	Replace pump.

QUADRAJET 4 MV DIAGNOSIS CHART

CONDITION											CHECK POINTS
HARD STARTING—COLD	HARD STARTING—HOT	COLD OPERATION	HESITATION	ACCELERATION FLATNESS	STALLING	ROUGH IDLE	ECONOMY	FLOODING	SURGE	LACK OF HIGH SPEED PERFORMANCE	**IMPORTANT** Before attempting carburetor diagnosis as outlinec below, all other engine systems must be operating properly. Diagnosis of these systems (electrical, exhaust, mechanical, and in the case of fuel economy, odometer accuracy) is found in this Service Manual. The numbers 1, 2 and 3, under the CONDITION are the order of probability. The * indicates additional possibilities.
1	1						1				Driver Habits (Instruct Owner on Proper Procedures)
*		4					*				Check Choke Rod Adjustment
*		5					*				Check Vacuum Break Adjustment
*		6									Check Thermostatic Choke Rod Adjustment
*		*									Check Choke Unloader Adjustment
2		1					2				Check Choke Valve & Linkage, Binding or Stuck
			*	2						3	Air Valve Binding, Stuck, Wrong Spring Tension Adj.
			*	1						*	Check Air Valve Lock-Out Adjustment
			*	4						*	Air Valve Dashpot Binding on Sticking
			*	*						*	Secondary Metering Rods Bent, Wrong Part
			*								Secondary Baffle Plates Missing
			*	*						*	Secondary Main Discharge Nozzles Plugged or Dirty
				3			3		3	*	Power Piston Stuck or Binding
							*		*		No Vacuum to Power Piston
							4		*	*	Primary Metering Rods Altered, Bent or Wrong Part
*		7	1								Check Accelerator Pump System & Adjustment
*	*	*	*		4						Throttle Return Check Misadjusted or Leaking Vacuum
4	*			*	*					*	Fuel Pump Pressure or Volume Not to Specification
					1	1					Check Slow Idle Adjustment
3		2									Check Fast Idle Adjustment
		*			*	*	*		1	*	Primary Metering Jets Plugged, Loose, Wrong Part
*	*	*		*		*	*	2	4	*	Float Sticking or Level Misadjusted
*	*	*				*	*	3	*		Float Bowl Porous, Cracked, Etc.
*		*		*	*	*				*	Throttle Body to Float Bowl Screws Loose
*	2	*			*		*	1	2		Float Needle Leaking
	*	*	*		*	4		*			Idle Compensator Not Opening or Closing
					*	3					Idle Passages Plugged or Dirty
				5	*	*	*		*		Crankcase Vent Valve Plugged
*		*		*	*				*	*	Fuel Filter in Gas Tank Plugged
				*	*			*	*	*	Fuel Filter in Carburetor Plugged or Dirty
	*	*		*	*	*	6	*	*		Air Cleaner Element Plugged
*		*		*	*				*	*	Hole in Fuel Pump Suction Line
		*	3	*	2	2	*			2	Check Auto. Trans. Throttle Switch Adjustment
		3	2				5				Heat Riser Valve Stuck Open or Closed
*	*	*	*		3	*			*		Secondary Throttle Valves Sticking Open
										1	Check for Full Throttle Position at Carburetor

QUADRAJET CARBURETOR SPECIFICATIONS
MODEL 4MV

Throttle Bore	
Primary	1-3/8"
Secondary	2-1/4"
Main Venturi	
Primary	1.093"
Secondary	.625"
Tertiary	.281"
Float Level Adjustment	
All Except 693 . . . 1/4 (Approx.)	.240"
693 Only . . . . . 11/32 (Approx.)	.350"
Air Valve Dashpot Adjustment	.030"
Air Valve Lockout Adjustment	.015"
Secondary Metering Rod Hanger	
Service Hanger Only	.840"
Secondary Throttle Closing	
Adjustment	.020"
Air Valve Spring Windup Adjustment	1/2 turn
Choke Rod Adjustment	.090"
(Setting)	Index
Vacuum Break Adjustment	.230"
Pump Rod Adjustment . . . . . (11/32")	.344"
Outer hole capacity 7.0 to 10.0 cc per 10 strokes	
Unloader Adjustment	.300"
Fast Idle Setting - RPM	
(A/C off)	1900-1950
Idle Speed Up setting - RPM	
(A/C on)	900-950
Curb Idle - RPM (In drive)	550

METERING SPECIFICATIONS
For 693 Series

Primary Side	INCH
Idle Tubes	.033
Channel Restrictions	.038
Auxiliary Well Bleeds	.030
Side Well Bleeds	.050
Top Well Bleeds	.050
Side Idle Bleeds	.047
Metering Rods Identification	42B
Metering Rods Economy End	.042
Metering Rods Power End	.026
Metering Jets	70C
Idle Mixture Screws	3 to 6 turns
Secondary Side	
Secondary Well Tubes	.033
Secondary Rods Identification	BH
Secondary Rod Wide Open Throttle Step	.040
Accelerating Well Feed Holes	.040
Accelerating Well Discharge Holes	.045

METERING SPECIFICATIONS
For Series
680, 681, 682, 683, 697 and 698

Primary Side	INCH
Idle Tubes	.036
Channel Restrictions	.047
Auxiliary Well Bleeds	.030
Side Well Bleeds	.050
Top Well Bleeds	.050
Side Idle Bleeds	.047
Metering Rods Identification	44B
Metering Rods Economy End	.044
Metering Rods Power End	.026
Metering Jets	70C
Idle Mixture Screws	3 to 6 turns
Secondary Side	
Secondary Well Tubes	.033
Secondary Rods Identification	BH
Secondary Rod Wide Open Throttle Step	.040
Accelerating Well Feed Holes	.040
Accelerating Well Discharge Holes	.045

FUEL PUMP SPECIFICATIONS

NOTE: Testing to be done with entire car at room temperature.

Fuel pressure at idle speed	5-1/4 to 6-1/2 psi
Fuel pump discharge per stroke at cranking speed	28 cc. Minimum
Fuel pump discharge in 17 strokes at cranking speed	1 pint Minimum

TORQUE SPECIFICATIONS

Material Number	Application	Thread Size	Torque
SAE 1010	Carburetor to Intake Manifold Screw (Rear)	5/16-18	14 ft. lbs.
280-M	Carburetor to Intake Manifold Screw (Front)	5/16-18	10 ft. lbs.
260-M	Fuel Pump to Cylinder Block Screw	5/16-18	14 ft. lbs.
260-M	Fuel Pump to Cylinder Block Nut	5/16-24	14 ft. lbs.
NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings and steel classifications.			

Fig. 6-101 Special Tools

Key	Tool Number	Name
A	J-22646	1/4" Hex-Head Extension Driver
B	J-9789-01	Universal Gage Set
C	J-22769	Seat Remover

GENERAL DESCRIPTION

The engine in all 1969 Cadillac cars is of the overhead valve 90°, V-8 design. The cylinder bore diameter is 4.30 inches and the piston stroke is 4.06 inches, providing a piston displacement of 472 cubic inches. The engine has a compression ratio of 10.5 to 1, and develops 375 horsepower at 4400 rpm. Peak torque of 525 foot-pounds is developed at 3000 rpm. A three-quarter view of the engine and transmission used in all cars except the Fleetwood Eldorado, is shown in Fig. 6-102. The Fleetwood Eldorado engine and transmission are shown in Fig. 6-103.

Design Features

The cast iron cylinder block is designed with two 90° cylinder banks having four cylinder bores in each bank.

Cylinder numbering is by cylinder arrangement. The right front cylinder is number one, and the left front is number two. Cylinders on the right bank have odd numbers (1, 3, 5, and 7) and those on the left bank have even numbers (2, 4, 6, and 8).

The firing order is 1-5-6-3-4-2-7-8.

The crankshaft is designed to provide a 4.06 inch stroke. The cast nodular iron crankshaft has two and one-half inch diameter connecting rod journals and incorporates five three and one-quarter inch diameter main bearing journals with shell-type inserts of steel-backed aluminum and steel-backed babbitt construction. End thrust of the crankshaft is taken by the center main bearing. Six counterweights are integral with the crankshaft. A harmonic balancer is secured by four screws to a flange pressed on the front end of the crankshaft.

Connecting rods for pistons of opposite cylinders are carried side by side on the same crankpin. Shell type connecting rod bearings are steel-backed aluminum.

The cast aluminum pistons use two compression rings and one oil ring. To provide a non-scuffing surface when the engine is new, the pistons are tin-plated. A trough on the top of each piston increases the turbulence of the fuel mixture in the combustion chamber for more complete burning.

Piston pins are press-fitted into the connecting rods. Broached grooves in each piston pin bore

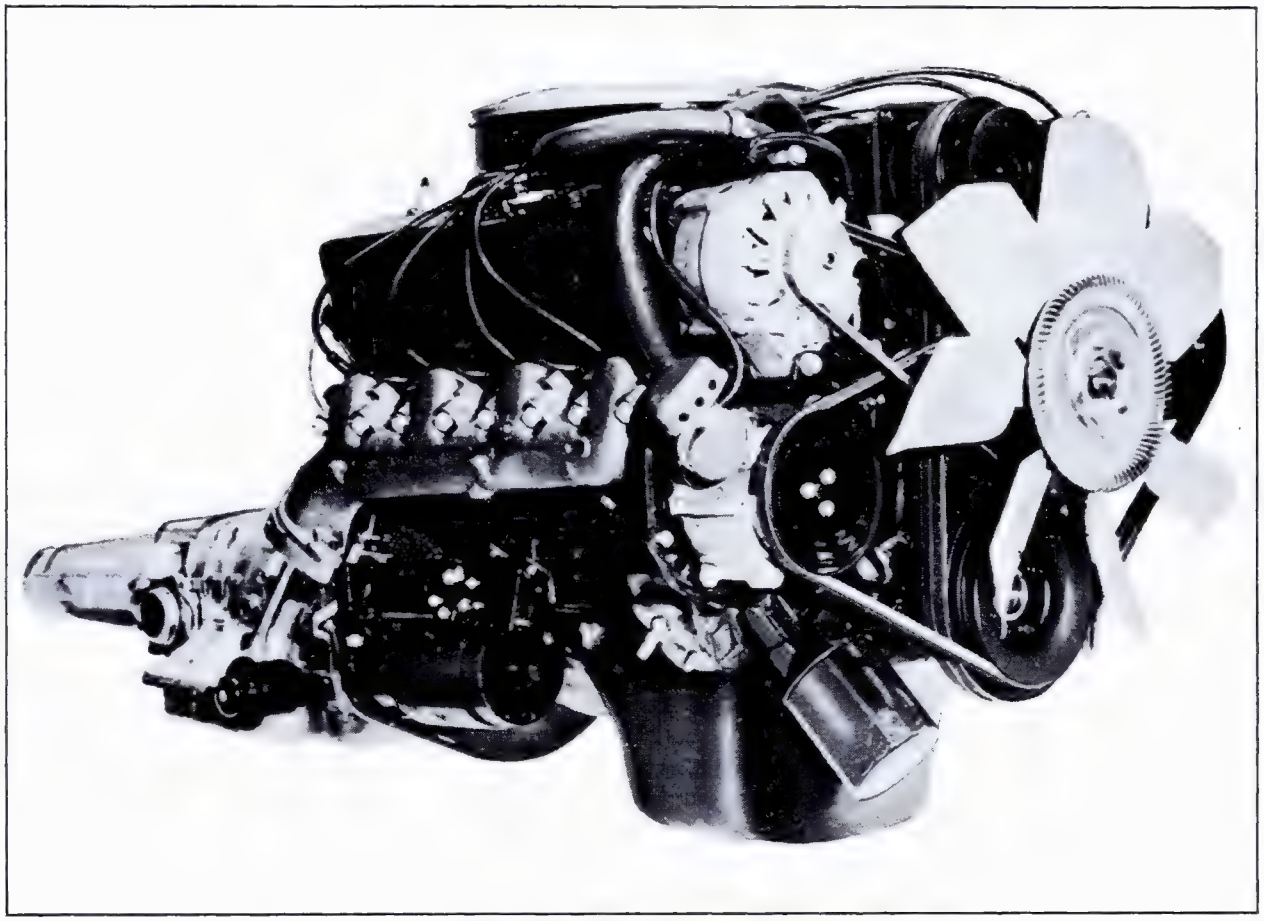


Fig. 6-102 1969 Cadillac Engine

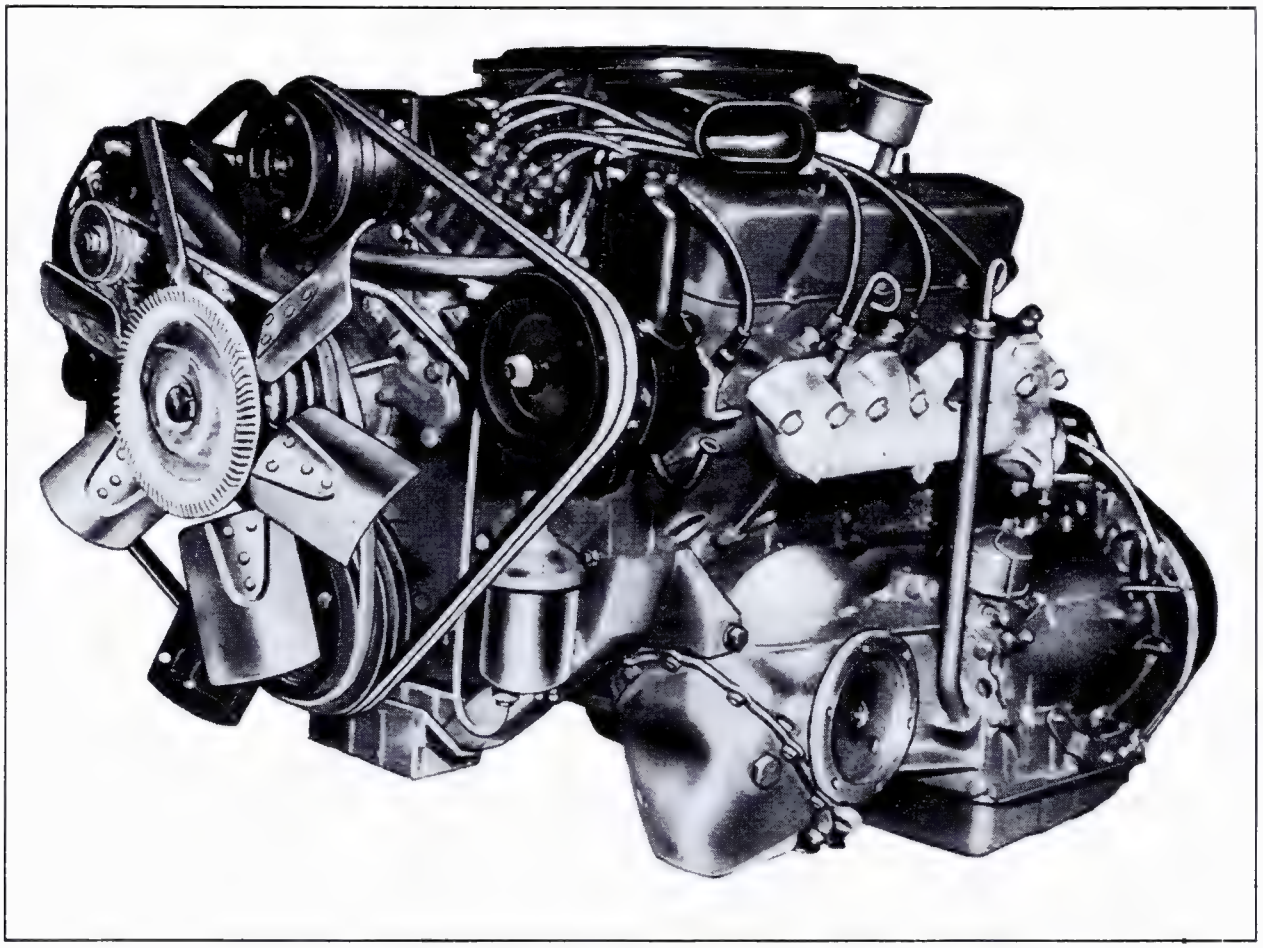


Fig. 6-103 1969 Cadillac Eldorado Engine

direct oil from the cylinder wall to the piston pin to provide adequate lubrication.

The camshaft is supported by five steel-backed babbitt bearings. It is driven by the crankshaft through a timing chain at the front of the engine. Both the crankshaft and camshaft sprockets have locating marks to provide correct valve timing when the timing chain is installed. Wide camshaft lobe design assures minimum lobe wear.

A drive gear, cast as an integral part of the camshaft, meshes with the driven gear on the distributor drive shaft, Fig. 6-104. The distributor drive shaft rotates in a clockwise direction when viewed from above. This shaft also drives the oil pump.

Hydraulic valve lifters are used to maintain zero operating clearance throughout the valve train. This arrangement assures quiet operation and eliminates the need for valve tappet adjustments. The lifters operate in guide holes bored in the cylinder block. The valve lifter plunger and lifter body are selectively fitted in matched pairs. The push rods ride in cups in the lifters and extend up through openings in the cylinder heads to the rocker arms. The valve operating mechanism is illustrated in Figs. 6-105 and 6-107.

A full flow type oil filter is attached to the oil pump housing. The filter assembly incorporates a throw away type filter element and a spring loaded by-pass valve integral with the pump assembly, to assure that the engine oil supply is not interrupted if the element should become clogged.

Oil capacity of the engine crankcase on all series cars except the Fleetwood Eldorado is four quarts; five quarts should be added if the filter is changed.

Oil capacity of the Fleetwood Eldorado crankcase is five quarts; six quarts should be added if the filter is changed.

1969 Cadillac engines designed for operation in certain foreign countries where high octane motor fuel is not readily available are designated "low compression" engines and may be identified by letters "L.C." immediately following the Vehicle Identification Number at the rear of the crankcase.

Engine Lubricating System

The oil pump is mounted on the right side near the front of the engine. Oil enters the pump through a screened intake pick-up pipe, and is pumped through the oil filter, through an angular passage in the cylinder block into the right longi-

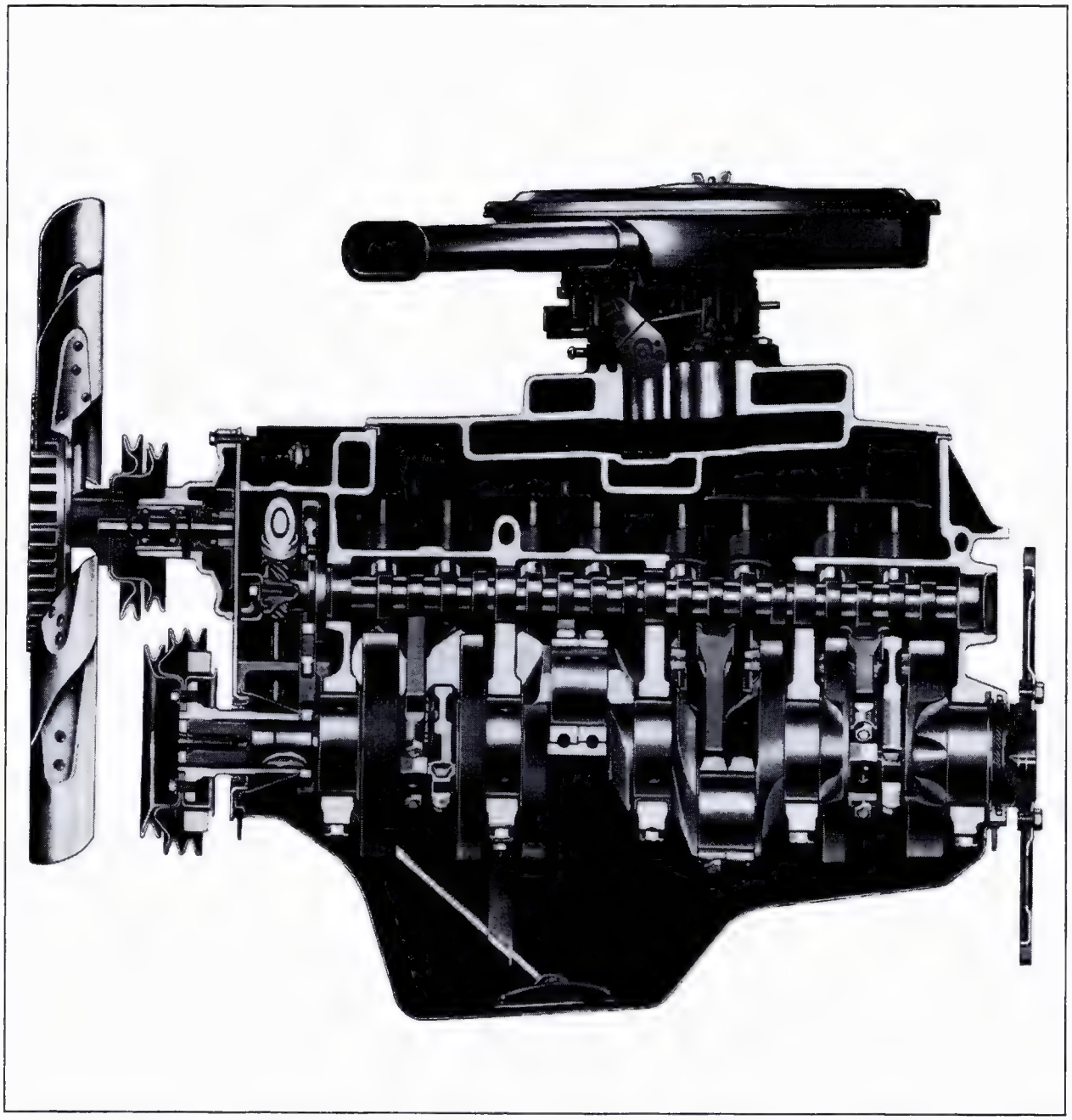


Fig. 6-104 Engine Longitudinal Section

tudinal header, Fig. 6-106, and crosses over to the left longitudinal header through intersecting vertical passages above the No. 2 camshaft bearing.

The oil continues up the left longitudinal header to the oil pressure signal switch.

Main bearings No. 2, 3, and 4 are lubricated by oil from the right longitudinal header through holes drilled in the block. Main bearings No. 1 and 5 are lubricated in the same manner by oil from the left longitudinal header. The camshaft bearings are lubricated by oil from the corresponding main bearings through holes drilled in the block. Oil from each main bearing also lubricates adjacent connecting rod bearings through holes drilled in the crankshaft. (See Fig. 6-106).

The longitudinal headers feed the hydraulic valve lifters through drilled passages. The oil then flows, under pressure, into the lifters and up through the hollow push rods to the rocker arms. The amount of oil is controlled by a small metering disk in the valve lifter.

The oil comes through a small feed hole in the rocker arm and flows onto the arm, lubricating the rocker arm bearings as well as the push rod tip and the valve tip.

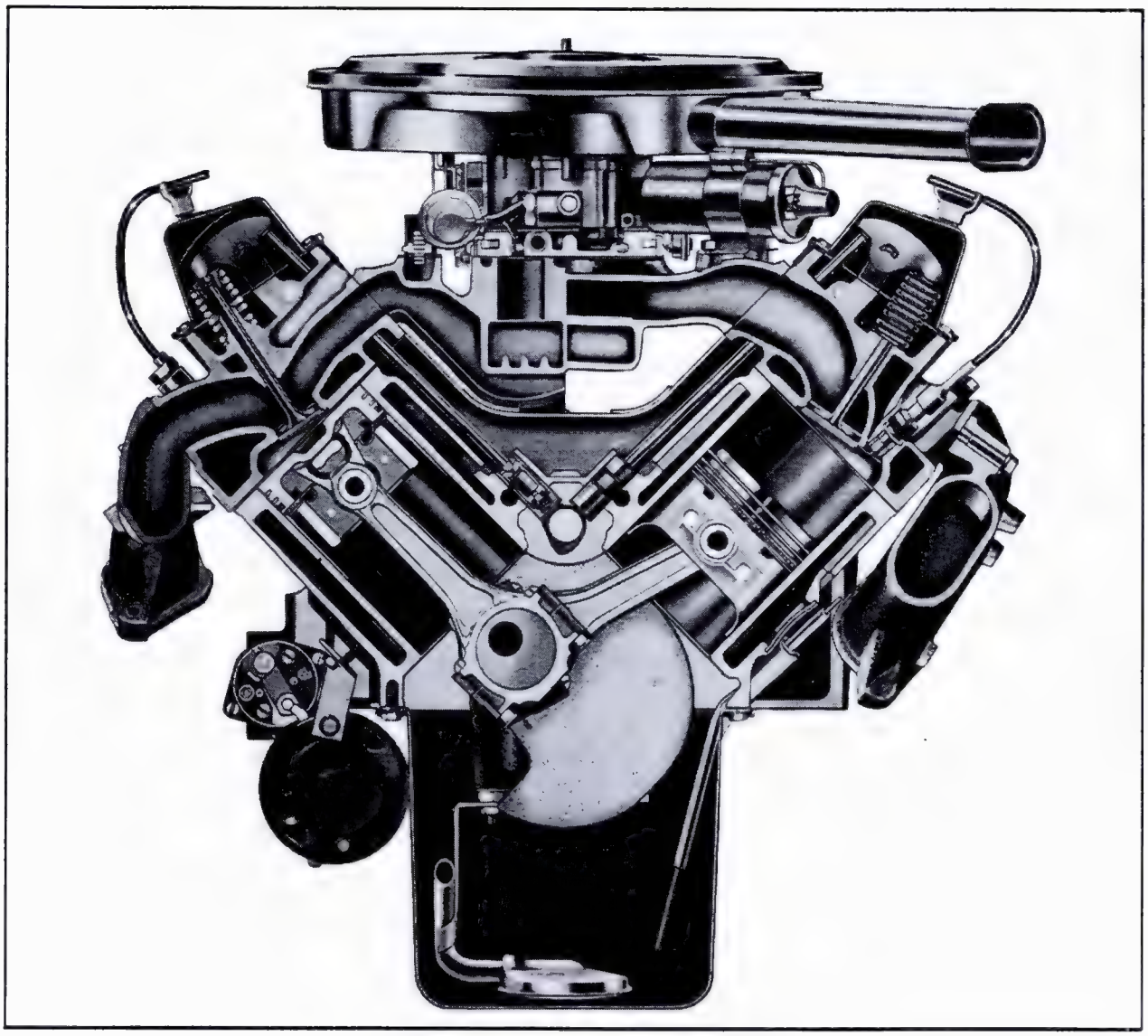


Fig. 6-105 Engine Transverse Section

Oil drains from the cylinder heads into the valve lifter compartment and returns to the crankcase through a hole on the bottom of the compartment.

Information pertaining to the Crankcase Ventilation System is given at the rear of the Engine Fuel Section.

110. Engine Removal and Installation

a. Removal

1. Disconnect negative battery cable.
2. Remove hood as described in Section 11, Note 2a.
3. Remove carburetor air cleaner and automatic level control hoses if so equipped.
4. Disconnect carburetor linkage at pedal lever.
5. Disconnect Cruise Control linkage on cars so equipped.
6. Remove clamp securing upper radiator hose to cradle.
7. Disconnect wire from ignition coil positive terminal.
8. Disconnect single connector under ignition coil; green wire to temperature sender.
9. Disconnect wires from transmission downshift switch.
10. On cars equipped with air conditioning, disconnect compressor lead at double connector on compressor and remove black wire from connector.
11. Remove clips securing wiring harness to left rocker arm cover and position wire harness out of way.
12. Remove four nuts securing fan clutch to pulley and remove fan.
13. Remove studs from water pump shaft hub for clearance on 693 only.
14. Disconnect power brake and vacuum modulator lines from fitting on rear of carburetor.

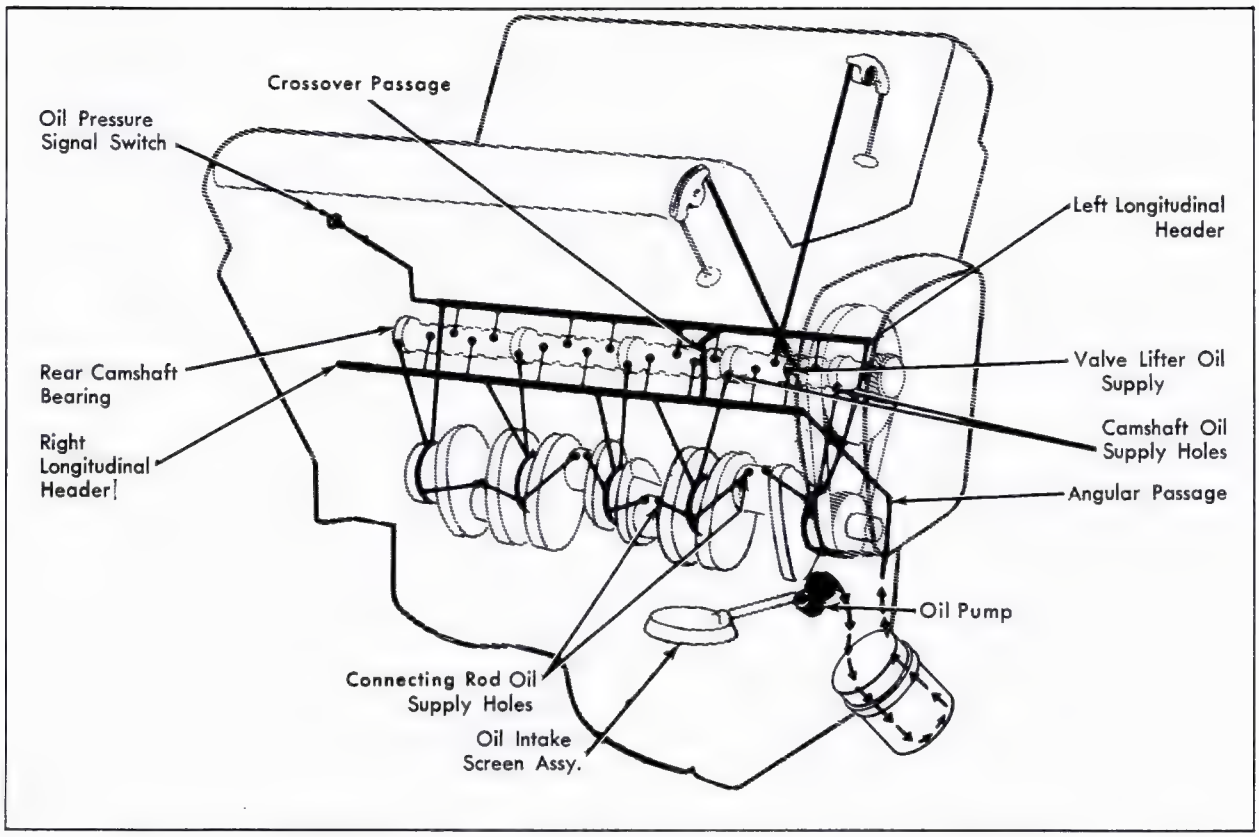


Fig. 6-106 Engine Lubricating System

15. Remove vacuum line from fitting on right rear of intake manifold.

16. Remove Cruise Control power unit as described in Section 15, Note 28a, on cars so equipped.

17. Disconnect fuel line between fuel pump and chassis fuel line. Disconnect vapor return line.

18. On cars equipped with air conditioning, partially remove compressor as described in Section 1, Note 10a.

19. Partially remove power steering pump as described in Section 9, Note 7a.

20. Remove screws securing power steering cooler and position out of way.

21. Drain radiator. Remove radiator-to-reservoir hose and place on pet cock if coolant is to be saved.

22. On cars equipped with air conditioning, remove idle speed-up hose, white striped, from idle speed-up device on carburetor.

23. Remove green hose from thermo vacuum switch at cowl connection.

24. Remove wire from engine temperature switch on rear of left cylinder head (front of right head on 693 series).

25. On Eldorado, remove one screw holding transmission filler tube to cylinder block.

26. Disconnect upper radiator hose at radiator fitting and thermostat housing.

27. Loosen A.I.R. pump and remove belt.

28. Remove water pump pulley.

29. Remove generator as described in Note 36a.

30. Disconnect clamps securing wiring harness to right rocker arm cover and position harness out of way.

31. Remove two upper transmission to engine screws. Right screw secures transmission dipstick and modulator line to engine.

32. Disconnect heater hose from water control valve.

33. Remove two screws securing right air deflector to lower radiator cradle.

34. Disconnect fuel line from fuel pump and vapor return line from fuel pump. Plug hoses to prevent drainage.

35. On cars equipped with air conditioning, remove power servo from heater air selector as described in Section 1, Note 43a (except 693).

36. On cars equipped with air conditioning, except 693, remove blower relay from heater air selector assembly.

37. Disconnect ground straps from cowl at rear of heads.

38. Remove two nuts securing tie struts to dust shield and one nut securing it to cowl and remove tie struts.

39. Raise car and place on jack stands.

40. Remove two nuts securing each front engine mount to frame.

41. Remove oil filter.

42. On 693 remove right output shaft as described in Section 3, Note 39a.

43. Remove three screws securing starter motor to engine. Allow starter motor to hang by cables.

44. Remove four screws securing converter cover to transmission bell housing and remove inspection pan.

45. Disconnect exhaust pipes from exhaust manifolds and remove heat riser from right hand manifold.

46. Place a jack stand under exhaust pipes to support system when engine is removed.

47. Connect a chain to the lifting brackets already installed on the engine.

48. Position hook of hoisting device to chain connected in Step 45.

49. Place a floor jack under transmission oil pan to support transmission.

50. Remove four lower transmission to engine screws.

51. Remove three screws securing converter to flex plate.

52. Remove lower radiator hose.

53. Pry engine forward while raising it as far as possible.

54. Lower transmission and again raise engine.

55. Remove flex plate from engine.

56. Lift engine free of car.

b. Installation

1. Install flex plate on engine. Torque screws to 75 foot-pounds.

2. Position engine over engine compartment. Lifting chain should be positioned so that engine hangs with front of engine high.

3. Raise transmission as high as possible.

4. Lower engine into car. Use care not to damage heater air selector, throttle linkage or transmission filler pipe. It may be necessary to twist the front of the engine to the left and pry engine rearward.

5. Once engine is in engine compartment, reposition chain to allow engine to be lowered flat.

6. Align engine with transmission.

7. Lower engine so that forward engine mounts engage holes in frame.

8. Install six transmission housing to engine screws. On all cars except 693, transmission oil filler tube and vacuum modulator brackets go under upper right screw. Tighten screws to 30 foot-pounds.

9. Remove lifting chains.

10. Install three flex plate to torque converter screws. Tighten screws to 30 foot-pounds.

11. Install converter cover tightening four screws to 5 foot-pounds.

12. Install starter tightening three screws to 30 foot-pounds.

13. Install nuts on front engine mount studs, two nuts on each mount, tighten nuts to 30 foot-pounds.

14. Install heat riser on right hand manifold and position exhaust pipes to manifolds, securing with two nuts at each manifold. Torque nuts to 33 foot-pounds.

15. Remove jack from under transmission and jack stand from under exhaust system.

16. Install lower radiator hose.

17. Install oil filter.

18. On 693 install right output shaft as described in Section 3, Note 39b.

NOTE: Be sure special alignment procedure described in Section 3, Note 39b is followed.

19. Install power brake vacuum hose to fitting on rear of carburetor.

20. Install vacuum modulator hose to fitting on rear of carburetor.

21. On cars equipped with air conditioning, install power servo on heater air selector assembly as described in Section 1, Note 43b.

22. On cars equipped with air conditioning, except 693, install blower relay on heater air selector assembly with black/white wire under one screw. Connect red three-way connector and single connector to relay.

23. Attach fuel line to fuel pump and reconnect vapor return line.

24. Install power steering pump as described in Section 9, Note 7b.

25. Install power steering pump cooler with two screws.

26. Install generator as described in Note 36b. Route wiring harness along right rocker arm cover and secure with clips. Install one wire on ground post, three wires at positive post and connect to generator. Place insulating cap over positive post.

27. On cars equipped with air conditioning, install compressor as described in Section 1, Note 10b.

28. Install studs in water pump shaft hub and install pulley and fan assembly as described in Note 8b or 9b.

29. Install all belts and tension as described in Note 11.

30. Install upper radiator hose to radiator. Secure hose to cradle with clamp and screw.

31. Install right air deflector, securing with two screws.

32. Connect heater hose to water control valve.

33. Connect ground straps at rear of each cylinder head to cowl. Connect wiring connector to sending unit of engine temperature warning system at rear of left cylinder head (all except 693) or front of right cylinder head (693 only).

34. On Eldorado, install one screw holding transmission filler tube to block.

35. Install Cruise Control power unit as described in Section 15, Note 28b.

36. Connect Cruise Control and throttle linkage to accelerator pedal lever.

37. Route wiring harness along left rocker arm cover and secure with clips.

38. Position terminal on black wire into vacant position of double connector near coil. Connect double connector to compressor clutch.

39. Connect terminal to coil positive post.

40. Connect single connector to water temperature sender near coil.

41. Attach orange with black and orange with white wires to transmission downshift switch.
42. Install transmission dipstick.
43. On cars equipped with air conditioning, connect vacuum hose, white stripe, to idle speed-up device. Connect green hose from thermo vacuum switch to connector at cowl.
44. Secure tie struts to cowl with one screw and to dust shields with two nuts.
45. Install finger guard to radiator cradle and secure with six screws.
46. Close radiator drain and remove overflow hose.
47. Position overflow hose on fitting at neck of radiator, and to coolant reservoir.
48. Refill cooling system.
49. Check engine oil and adjust to proper level.
50. Visually inspect engine compartment and attach any hoses, wiring or items missed.
51. Install air cleaner and automatic level control hoses if so equipped.
52. Lower car.
53. Connect negative battery cable.
54. Start engine and visually check for leaks.
55. Shut off engine.
56. Install hood as described in Section 11, Note 2b.

111. Intake Manifold

a. Removal

1. Disconnect negative battery cable.
2. Remove carburetor air cleaner.
3. Disconnect carburetor linkage at pedal lever.
4. Disconnect Cruise Control linkage at pedal lever.
5. Disconnect primary wires at coil.
6. Remove ignition cable between coil tower and distributor cap.
7. Disconnect single connector at coil.
8. Disconnect Orange/Black and Orange/White wires from downshift switch.
9. Remove ignition coil from manifold.
10. Disconnect double connector from compressor clutch on cars equipped with air conditioning.
11. Disconnect power brake and vacuum modulator lines from fittings at rear of carburetor.
12. Disconnect vacuum hose from fitting at right rear of manifold.
13. Remove fuel line between fuel pump and carburetor.
14. Disconnect right ignition wires at spark plugs and position out of way.
15. Disconnect A.I.R. hose from check valve.
16. On cars equipped with air conditioning, partially remove compressor as described in Section 1, Note 10a.
17. On cars equipped with air conditioning, disconnect vacuum hose, white stripe, from idle speed-up device.
18. Disconnect PCV valve from right rocker arm cover.
19. Disconnect distributor vacuum advance hoses at carburetor and position out of way.
20. Remove twelve screws securing manifold to cylinder heads.
21. Remove manifold.
22. Remove rubber front and rear manifold to cylinder block gaskets.
23. Remove sheet metal manifold gasket.

b. Installation

1. Cement sheet metal gasket on engine. Triangular shaped piercings on gasket should catch underside of manifold mating surfaces on cylinder head and holes should all line up. Indentations around holes should be positioned into holes.
2. Place rubber gaskets over rails at front and rear of cylinder block. Tabs on gaskets should be positioned in holes in rails and beveled ends of gasket tucked into slot at mating of head and rail.
3. Carefully position manifold on engine.
4. Secure manifold to cylinder heads with twelve screws. Tighten screws to 30 foot-pounds.
5. Connect distributor vacuum advance hoses to carburetor.
6. Connect PCV valve to right rocker arm cover.
7. On cars equipped with air conditioning, connect vacuum hose, white striped, to idle speed-up device on carburetor.
8. On cars equipped with air conditioning, install compressor as described in Section 1, Note 10b.
9. Check A.I.R. hose to check valve.
10. Install ignition wires on spark plugs.
11. Install fuel line between fuel pump and carburetor.
12. Connect power brake vacuum hose to fitting at rear of carburetor.
13. Connect power brake and vacuum modulator lines to fittings at rear of manifold.
14. On cars equipped with air conditioning, connect double connector with Black and Black/White wires to compressor clutch.
15. Connect single connector at coil location.
16. Install coil on car.
17. Connect coil primary wires to coil terminals.
18. Install coil to distributor ignition cable.
19. Install Orange/Black and Orange/White wires to downshift switch.
20. Connect Cruise Control linkage to pedal lever.
21. Connect throttle linkage to pedal lever.
22. Install carburetor air cleaner and automatic level control hoses, if so equipped.
23. Connect negative battery cable.

112. Exhaust Manifold—Right or Left

a. Removal

1. Remove two nuts securing header pipe to exhaust manifold on side being worked on.
2. Remove eight screws securing exhaust manifold to cylinder head.
3. Remove exhaust manifold from position in car.

b. Installation

1. Position exhaust manifold in location on cylinder head.
2. Secure exhaust manifold to cylinder head with eight screws. Torque screws to 35 ft. lbs.
3. Install new exhaust pipe packing in end of exhaust pipe.
4. Move exhaust pipe into position at manifold outlet and secure with two nuts.

113. Rocker Arm Covers

a. Removal

1. If working on left side, remove air cleaner and crankcase ventilating breather. Remove wiring harness from clips.
2. If working on right side, remove PCV valve and elbow from cover. Remove wiring harness from clips.
3. Remove four spark plug cables, cable holder on cover and position out of way.
4. Remove nine screws holding cover to head and remove cover.

b. Installation

1. Using a new gasket, position cover on cylinder head and secure with nine screws. Tighten screws to 30 in. lbs.

NOTE: Cover with oil filler cap provision goes on right side of engine.

2. Connect spark plug leads to spark plug terminals according to Fig. 6-54, page 6-46.
3. Position spark plug cable holder on tab of rocker arm cover.
4. If working on right side, install PCV valve and elbow. Reposition wiring harness under clips.
5. If working on left side, install crankcase ventilating breather and air cleaner. Reposition wiring harness under clips.

114. Valve Lifters—Noisy Operation

Noisy operation of valve lifters may be due to:

a. Incorrect Oil Level in Crankcase

Oil level should never be above, nor more than a quart below "Full" mark on indicator. If level is too high, foaming may result, if too low, air may enter pump inlet. In either case, noisy valve action may result.

b. Improper Oil Pressure

If valve action is noisy after the oil is hot, it may be due to low oil pressure.

Low pressure usually results from an external leak in the engine lubrication system, a stuck or improperly operating oil pressure relief valve, scored parts, worn bearings, worn oil pump gears, clogged oil intake strainer screen assembly, or poor operation of oil pump.

c. Rusty or Varnished Valve Stems or Valve Guides

This condition may be associated with short trip operation, poor quality engine oil, or failure to change oil regularly.

d. Weak Valve Lifter Springs

These can cause noisy valve operation by causing sluggish plunger movements in the cylinder. To check these springs, disassemble plunger assembly, clean thoroughly and reassemble. Check pressure to compress spring with lifter dry.

If pressure required to compress spring 11/32 inch is less than 6-1/4 pounds, the assembly should be replaced.

e. Dirty, Worn, or Scored Valve Lifter Parts

A recurring tap or click synchronized with valve action, indicates trouble in a single lifter assembly, which should be disassembled and checked for:

1. Dirt or foreign particles, which can be removed after disassembly by wiping with a soft cloth and washing in kerosene.
2. Varnish or heavy sludge material, which can be removed by the use of a proper solvent.

NOTE: The engine oil pan should always be removed and cleaned when dirt has been responsible for sticking lifters. The oil passages from the header to the lifter bores should also be cleaned thoroughly by blowing out with kerosene and air.

3. Pitting and scoring of surfaces, which may result from gritty particles, excessive wear, poor grade oil, or damage during installation. This condition requires replacement of the complete unit.
4. Incorrect clearance between cylinder and plunger, usually caused by mismating of parts. These parts are selectively fitted in manufacturing and are not interchangeable, Fig. 6-107.

f. Lifters That Do Not Turn in Their Bores

Scoring, surface flaking, cupping or excessive wear on the bottom of the lifter may prevent the lifters from turning in their bores.

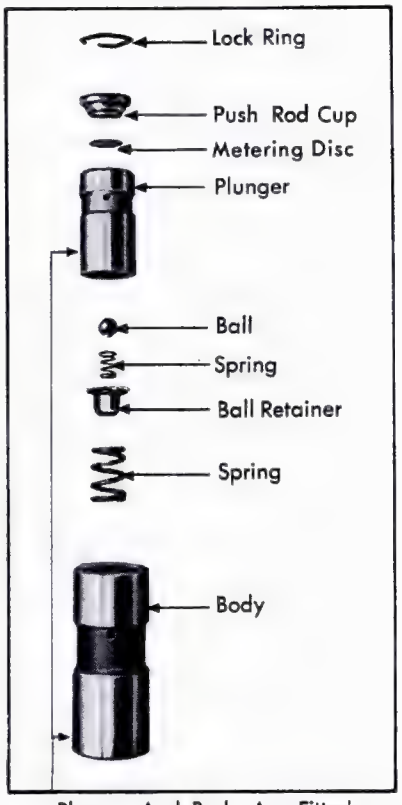
g. Other Causes

Excessive wear on either end of rocker arm or at rocker arm support; worn valve stems or push rods; worn camshaft lobes; air in suction side of oil pump system.

115. Valve Lifter Leak-Down Rate Checking

The Valve Lifter Leak-Down Rate Tester, J-3074, is used to obtain a comparison of leak-down rates of hydraulic valve lifters without removing them from the engine. With this tool, a feeler gage of a given thickness is placed be-

ARRANGEMENT OF VALVES AND VALVE LIFTERS



Plunger And Body Are Fitted Pairs And Must Not Be Mismated.

OPERATION OF VALVE LIFTER MECHANISM

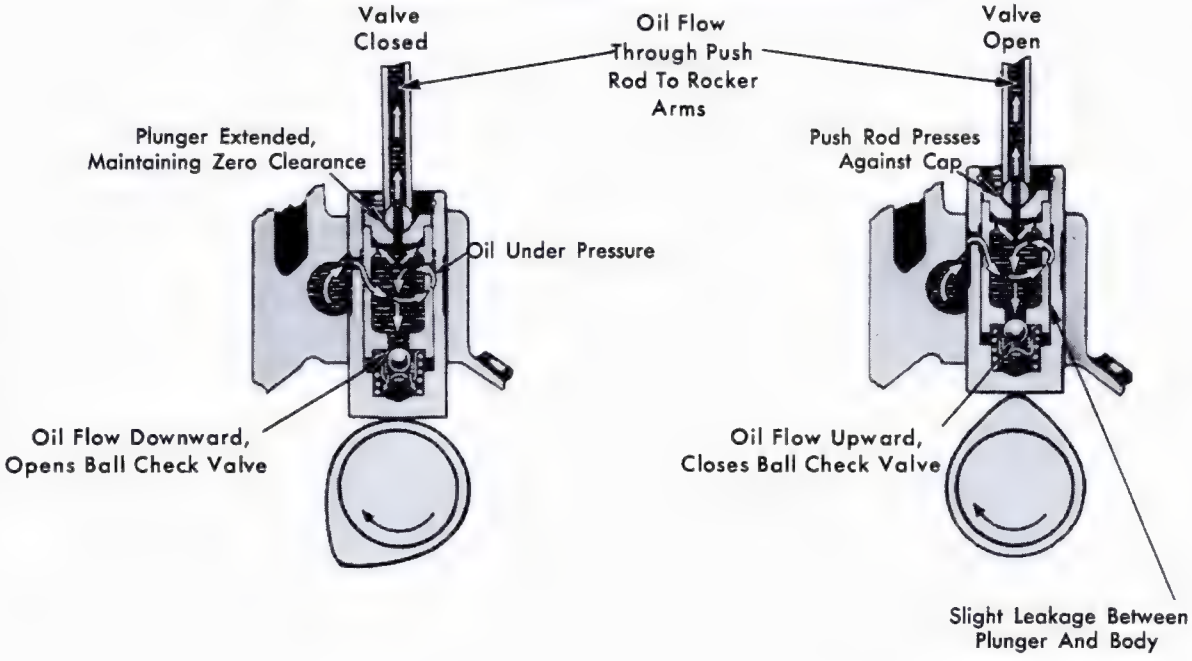


Fig. 6-107 Valve Lifter Mechanism

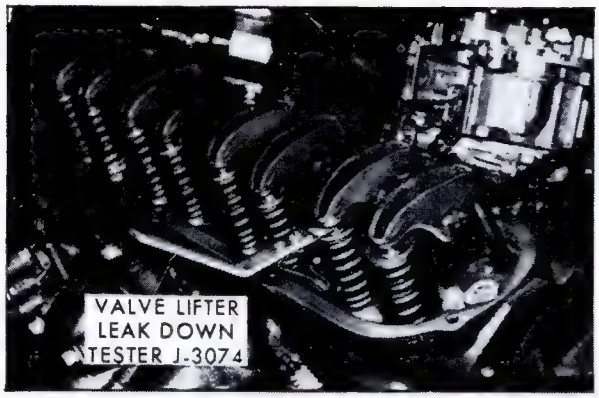


Fig. 6-108 Checking Lifter Leak-down Rate

tween the rocker arm and the valve stem, causing valve spring pressure to force oil out of the lifter.

A spring, attached to the tool and compressed against the valve spring retainer, ejects the feeler gage when the lifter has leaked down enough to allow the valve to seat. By observing the length of time required by each lifter to leak-down the thickness of the feeler gage, a faulty lifter or lifters can be easily located.

Use the following procedure:

1. Operate engine to allow lifters to fill with oil.
2. Turn off engine. Remove distributor cap and rotate crankshaft so that rotor is at No. 1 firing position.
3. Remove carburetor air cleaner.
4. Disconnect negative battery cable.
5. Disconnect spark plug wires at plugs and remove wiring from tabs on rocker arm covers, but leave wiring connected.
6. Remove rocker arm covers.
7. If car is equipped with Cruise Control, disconnect accelerator linkage rod at control unit.
8. Check each lifter listed in following table as shown in Fig. 6-108.

Rotor at No. 1 firing position.
Check:

1 Intake	1 Exhaust
2 Intake	3 Exhaust
5 Intake	5 Exhaust
7 Intake	6 Exhaust
8 Intake	8 Exhaust

9. Insert feeler gage of tool between valve stem and rocker arm and at the same time, compress tool "pop-out" spring to its stock against valve spring retainer, Fig. 6-108.

NOTE: Install tool as quickly as possible to eliminate any unnecessary lifter leak-down.

10. Note interval of time during which tool is held in place by valve spring pressure. The noisy lifter or lifters will have the shortest leak-down time.
11. Connect negative battery cable, install distributor cap, connect spark plug wires, and operate engine to allow lifters again to fill up with oil.
12. Turn off engine, remove distributor cap and rotate crankshaft so that rotor is at No. 4 firing position. Disconnect spark plug wires and negative battery cable.
13. Check each lifter listed in the following table:

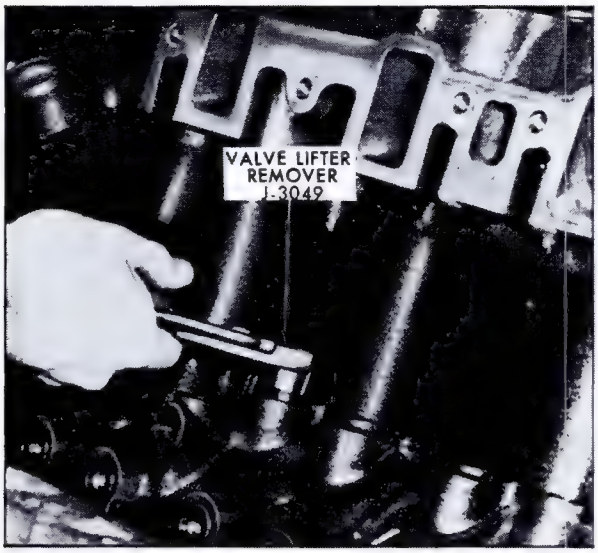


Fig. 6-109 Removing Valve Lifters

Rotor at No. 4 firing position.
Check:

3 Intake	2 Exhaust
4 Intake	4 Exhaust
6 Intake	7 Exhaust

14. Install rocker arm covers, using new gaskets, and connect spark plug wires at plugs. Tighten rocker arm cover screws to 30 inch-pounds. Secure wiring under rocker arm cover tabs.
15. If car is equipped with Cruise Control, connect accelerator linkage rod to control unit.
16. Install distributor cap.
17. Install carburetor air cleaner.
18. Connect negative battery cable.
19. Operate engine to obtain operating temperature and re-torque rocker arm cover screws to 30 inch-pounds.

116. Valve Lifter

a. Removal

1. Remove intake manifold as described in Note 111a.
2. Remove clips securing wiring harnesses to rocker arm covers and position harnesses out of way.
3. Remove screws securing rocker arm covers to cylinder heads.

Fig. 6-110 Removing Stuck Plunger from Body

4. Remove rocker arm covers and clean old gasket material from covers and heads.

5. Remove screws securing rocker arm supports to cylinder heads.

6. Remove rocker arm assemblies. Store rocker arm assemblies so that they can be reinstalled in same location.

7. Remove push rods. Store push rods with rocker arm assemblies.

8. Using a small screwdriver, or pointed tool, remove lifters from engine. Keep them in order so thay can be re-installed in same bores from which they were removed. Use Valve Lifter Remover, J-3049, to remove any lifters that are stuck, rotating lifter back and forth while lifting, Fig. 6-109.

b. Installation

1. Apply a small amount of rear axle lubricant to foot of each lifter.

2. Install valve lifters in same bores from which they were removed.

3. Install push rods through openings in cylinder heads. Bottoms of push rods must be seated in hydraulic valve lifter cups.

4. Install rocker arm assemblies on cylinder heads securing with screws. Tighten screws to 60 foot-pounds.

5. Position new rocker arm cover gaskets on cylinder heads.

6. Install rocker arm covers and secure with screws. Tighten screws to 30 inch-pounds.

7. Route wiring harnesses along upper side of rocker arm covers and secure with clips.

8. Install intake manifold as described in Note 111b.

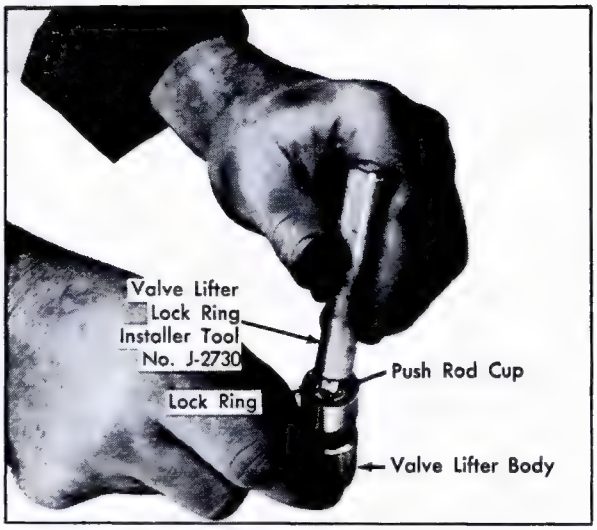


Fig. 6-111 Valve Lifter Lock Ring Installation

117. Valve Lifter Disassembly and Assembly

a. Disassembly

NOTE: Valve plungers and bodies are matched in pairs and are not interchangeable with one another. In order to fit properly, they must be reassembled to their original matching pairs.

1. Press down on center of valve lifter push rod cup.

2. Using a pointed tool, remove lock ring from groove while holding cup down.

3. Invert lifter and slide out push rod cup, metering disk, plunger, ball, small spring, ball retainer and spring.

If plunger is stuck in lifter body, place lifter, push rod end down, in Valve Lifter Plunger Remover, J-4160, Fig. 6-110. Holding tool firmly in hand with thumb over lifter body, strike tool sharply on block of wood or wooden bench until plunger falls out of body.

b. Assembly

1. Place ball on its seat in lower end of plunger while holding plunger upside down. Place small spring on ball.

2. Position ball retainer over small spring and ball and snap into recess in plunger.

3. Place spring over ball retainer.

4. Lower lifter body over plunger assembly on an angle to seat spring.

5. Turn assembly right side up and fill plunger with clean engine oil.

6. Jiggle ball with small piece of wire until oil drains out of plunger into body and trapped air is released from body.

7. Refill plunger with oil, place oil metering

disc and push rod cup on plunger, and position lock ring over cup.

8. Press lock ring into groove with Valve Lifter Lock Ring Installer, J-2730, Fig. 6-111.

118. Valve Spring and/or Valve Stem Oil Seal Replacement (On Car)

a. Removal

1. Disconnect negative battery cable.
2. Remove air cleaner if working on left side.
3. Disconnect PCV valve if working on right side or crankcase ventilating breather on left side.
4. Disconnect Cruise Control linkage if working on left side.
5. Disconnect spark plug cables from plugs and position out of way.
6. Remove nine screws securing rocker arm cover to cylinder head.
7. Remove rocker arm cover.
8. Remove screws securing rocker arm support to cylinder head.
9. Lift out rocker supports and rocker arms.
10. Remove push rods.
11. Remove spark plug in cylinder to be worked on.

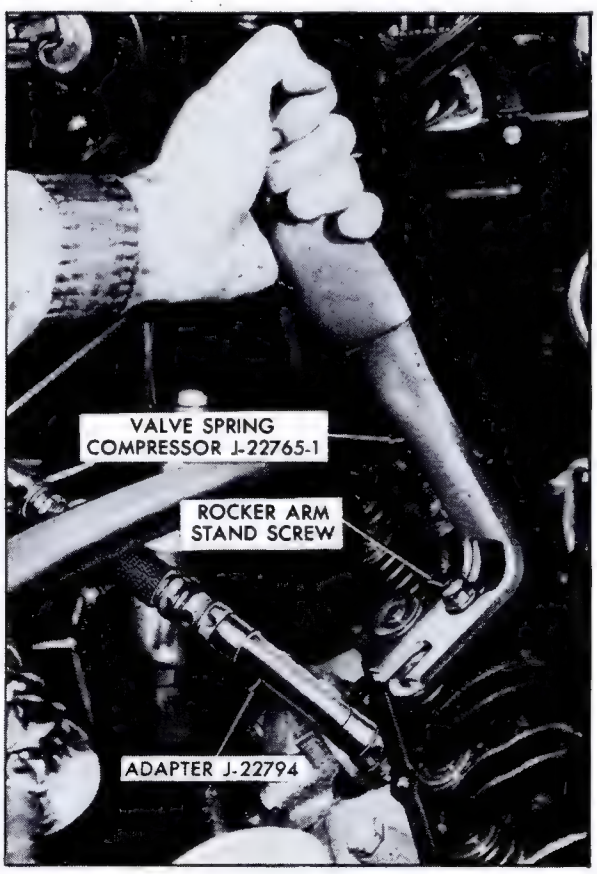


Fig. 6-112 Compressing Valve Spring

12. Install Adapter J-22794 in spark plug hole, Fig. 6-112.
13. Connect air hose to Adapter J-22794 and supply air to cylinder.
14. Install rocker arm support screws.
15. Pass Valve Spring Compressor, J-22765-1, over rocker arm stand screw, Fig. 6-112.
16. Compress valve spring and remove locks from valve stem.
17. Lift out spring retainer and spring, Fig. 6-113.
18. Clean gasket material off cylinder head and rocker arm cover.

b. Installation

1. Install valve spring and retainer, Fig. 6-113.
2. Using Valve Spring Compressor, J-22765-1, compress valve spring and install locks, Fig. 6-112.
3. Bleed air out of cylinder and remove air hose and Adapter J-22794.
4. Install spark plug.
5. Remove rocker arm support screw.
6. Install push rods.
7. Position rocker arm on rocker arm supports, Fig. 6-114.
8. Position retainer on rocker arm supports.
9. Position rocker arm assembly on cylinder head and secure with screws. Tighten screws to 60 foot-pounds.
10. Position new rocker arm cover gasket on cylinder head.
11. Install rocker arm cover.
12. Position wiring harness along side of rocker arm cover.
13. Install nine screws securing cover to cylinder head. Tighten screws to 30 inch-pounds.
14. Connect PCV valve to right rocker arm

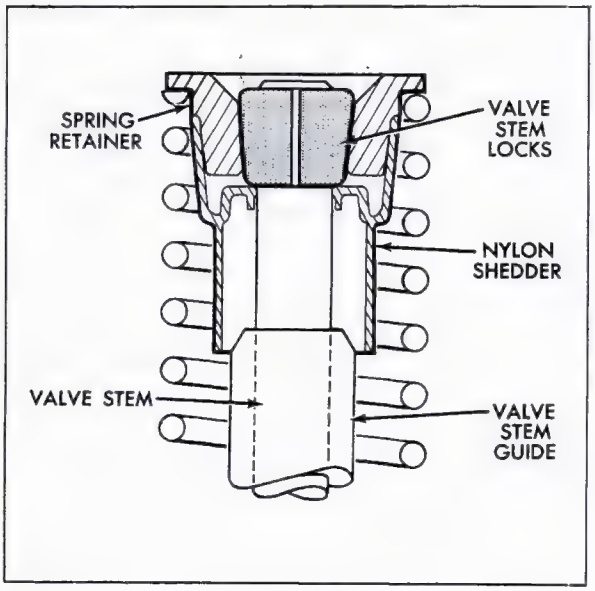


Fig. 6-113 Valve Spring Retainer and Oil Shedder

cover or crankcase ventilating breather on left side.

15. Install Cruise Control linkage if working on left side.

16. Install A.I.R. hose if working on right side.

17. Connect ignition wires to spark plugs.

18. Install carburetor air cleaner if working on left side.

19. Run engine and check for oil leaks.

119. Cylinder Head

a. Removal

1. Remove intake manifold as described in Note 111a.

2. Drain coolant from radiator.

3. Disconnect ground strap at rear of cylinder heads from cowl. Disconnect wiring connector for high engine temperature warning system from sending unit at rear of left cylinder head (all except 693) or front of right head (693 only).

4. Remove generator as described in Note 36a if working on right cylinder head, or partially remove power steering pump as described in Section 9, Note 7a, if working on left cylinder head.

5. Remove clamps securing A.I.R. manifold to both cylinder heads and remove A.I.R. manifold.

6. Remove clips securing wire harness to rocker arm covers and position harness out of way.

7. Remove screws securing exhaust manifold to cylinder head.

8. Remove nine screws securing rocker arm cover to cylinder head.

9. Remove rocker arm cover.

10. Remove screws securing each rocker arm support to cylinder head and remove rocker arm assemblies. Store rocker arm assemblies so that they can be reinstalled in same locations.

11. Remove push rods. Store push rods with rocker arm assemblies.

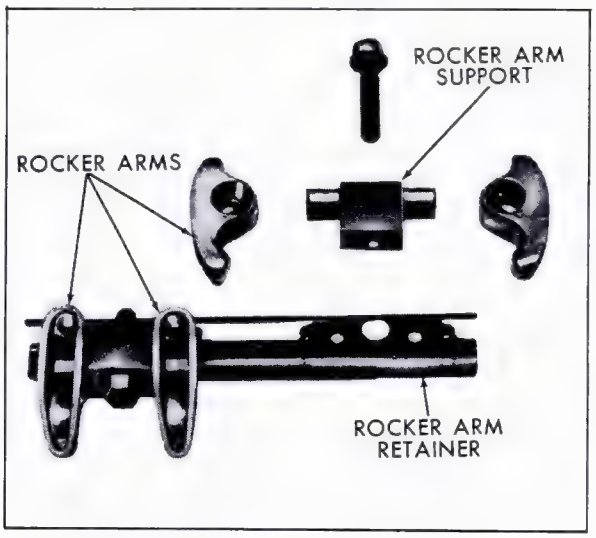


Fig. 6-114 Rocker Arms Disassembled

12. Install two 7/16" x 6" screws, to be used as lifting handles, in two of the rocker arm support screw holes.

13. Remove ten screws securing cylinder head to cylinder block.

14. Lift cylinder head off of cylinder block. Use care not to damage other parts of car that are in the work area.

15. Carefully remove all gasket material from mating surface of cylinder head and cylinder block.

b. Installation (Fig. 6-115)

1. Use extreme caution to insure that all mating surfaces of cylinder head and cylinder block are clean.

2. Position cylinder head gasket over dowels on cylinder block.

3. Position cylinder head on cylinder block.

4. Install ten cylinder head screws finger tight in locations as indicated in Fig. 6-115.

5. Tighten cylinder head screws to 115 foot-pounds starting from center of cylinder head and working toward both ends.

6. Remove two 7/16" x 6" screws used for lifting handles.

7. Install push rods through openings in cylinder head. Bottom of push rod must be seated in hydraulic valve lifter cup.

8. Position rocker arm assemblies on cylinder heads and secure with screws. Tighten screws to 60 foot-pounds, Fig. 6-114.

9. Install new rocker arm cover gasket on cover.

10. Install rocker arm cover and secure with nine screws. Tighten screws to 30 inch-pounds.

11. Install exhaust manifold to cylinder head and secure with eight screws. Tighten screws to 35 foot-pounds.

12. Position wiring harness along upper edge of rocker arm cover and secure with clips.

13. Position A.I.R. manifold in openings in front of cylinder heads and secure with clamps. Right-hand clamp (generator side) is installed with flanges facing cylinder head while lefthand clamp should be installed with flanges facing outward. Tighten clamp screws to 30 foot-pounds.

14. Install generator as described in Note 36b if working on right cylinder head, or power steering pump as described in Section 9, Note 7b, if working on left cylinder head.

15. Connect ground strap at rear of cylinder heads to cowl.

16. Connect high temperature warning wiring connector to sending unit at rear of left cylinder head (all except 693) or front of right head (693 only).

17. Install intake manifold as described in Note 111b.

18. Refill cooling system.

19. Operate engine to normal operating temperature and re-torque rocker arm cover screws. Check for coolant and oil leaks.

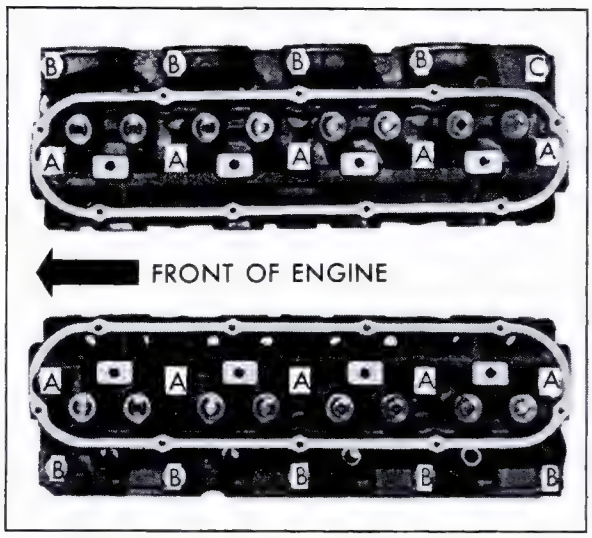


Fig. 6-115 Cylinder Head Screws

Bolt Location	Length
A (Bolt)	4.36"
B (Bolt)	4.77"
C (Bolt)	3.02"

120. Valve (Intake or Exhaust)

a. Removal

1. Remove cylinder heads as described in Note 119a.
2. Set cylinder head on clean work bench. Position cylinder head on intake manifold surface.
3. Position valve spring compressor over valve, Fig. 6-116 and compress valve spring.
4. Remove valve locks.
5. Slowly release tension on valve spring compressor and remove compressor.
6. Remove valve spring retainer, spring and oil shedder from cylinder head. Discard retainer and oil shedder.
7. Remove valve from cylinder head.
8. Repeat steps 3 through 7 for remaining valves to be serviced.

b. Installation

1. Position valve into cylinder head.
2. Position new valve spring oil shedder and valve spring retainer on valve stem.
3. Engage valve and retainer with valve spring compressor, Fig. 6-116 and compress valve spring.
4. Install valve locks on valve stems.
5. Slowly release tension on valve spring compressor and remove valve spring compressor.
6. Repeat steps 1 through 5 for remainder of valves to be installed.
7. Install cylinder head on engine as described in Note 119b.

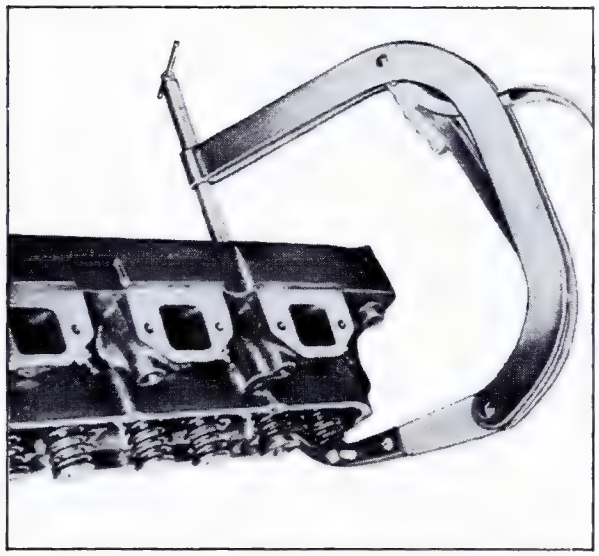


Fig. 6-116 Removing Valve

121. Valve and Seat Reconditioning

Valve reconditioning is normally required less frequently in engines having hydraulic valve lifters. When this work is done, the close limits given in the engine specifications, Page 6-110 and 6-111 must be maintained.

Check valve stem to guide clearance using a hole gage and an outside micrometer. Measure valve guide inside diameter with hole gage, crossways to engine, at both top and bottom of guide, measuring gage each time with micrometer. A standard size valve guide is .343" in diameter.

Measure valve stem diameter with micrometer and subtract from greater of two guide measurements to obtain maximum clearance. If clearance is greater than .005 inch, guide should be repaired to prevent excessive oil consumption and improper seating of valves.

An alternate method of checking valve stem to guide clearance, if a hole gage is not available, is by using a 1/16 inch wide strip of .005 inch brass shim stock on a "no-go" basis.

Bend end of shim and hang in end of valve guide, with tip extending towards push rod side of head. Shim should not extend more than 1/4 inch into guide. If valve stem will enter guide, clearance is excessive and guide should be repaired.

Service valves are available in standard (.343") and +.003", +.006", +.013" sizes. If clearance is found to be excessive as described above, guide should be reamed to the next oversize using the appropriate reamer, and a valve having a corresponding oversize stem should be installed.

The following tools are recommended for the reaming operation:

Size	Tool Number
+.003" (.346")	J-5830-1
+.006" (.349")	J-5830-6
+.013" (.356")	J-5830-7

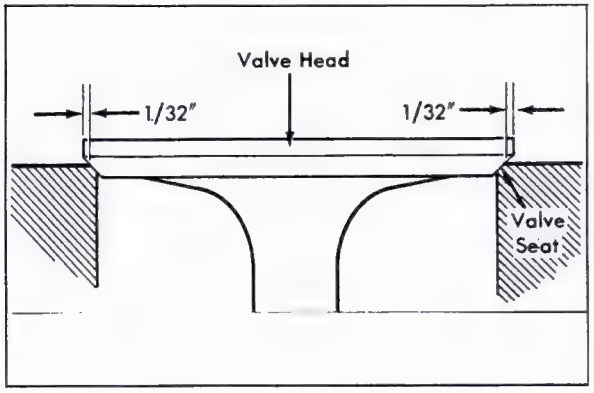


Fig. 6-117 Valve Seat Diameter

Valve guides with a .003" oversize diameter and .003" oversize valves are installed at the factory on some engines. Engines so fitted will be marked by a "3" stamped on the cylinder head gasket surface in line with the oversize valve.

All oversize valves will be so marked on the valve head so that they may be easily identified when part numbers are not available.

When an oversize valve is installed, be sure to stamp the oversize marking on the cylinder head gasket surface, as explained above, for future reference.

Check concentricity of all valve seats. This should be within .004 inch total, as measured with dial indicator and a solid, slightly tapered pilot which has a slight bind in the valve guide when installed.

CAUTION: A pilot of the correct size must be used. Do not attempt to drive pilot into guide. Pilots with adjustable diameters to fit various sized guides are not recommended.

Grind valve seats to within .002 inch indicator reading when new valves are being installed, or if concentricity, seat width, or full contact of valves is not as specified.

Check seat width and location on valve to insure proper heat dissipation and prevent build up of carbon on seats. Condition valve seat to a width of 3/64 to 1/16 inch. This seat width will insure good idle stability.

Valve seats should be cut on a 45° angle so that the seat is 1/16 inch smaller in diameter than the valve head, Fig. 6-111 to allow heat to escape and to provide maximum life for newly ground valves. The diameter of the seat can be checked by placing valve in position and then rotating to get a contact pattern with the seat.

New valves have a face angle of 44° to provide a line contact between the head of the valve and the valve seat in the cylinder head, which assures good seating of the valve and less chance of burning the valve head due to exhaust gas leakage. When reconditioing valves, always grind valve face angle to 44°.

Service valves should not have more than 1/64 inch wide contact with valve seats (due to 1° difference in angle) and should not be ground as they are ready to use just as you receive them. Grinding of valves by hand with grinding compound or lapping to seat them is not recommended. Use only precision equipment for valve and seat reconditioning, and follow equipment manufacturer's instructions.

122. Engine Oil Pan— Removal and Installation

a. Removal

1. On 693 cars remove engine from vehicle chassis as described in Note 110a and proceed with steps 9 and 10.
2. Disconnect negative battery cable.
3. Drain engine oil.
4. Remove exhaust "Y" pipe at exhaust manifold as described in Section 8, Note 6a.
5. Remove starter motor as described in Note 26a.
6. Remove two idler arm support mounting screws and lockwashers from frame side member, and lower support.
7. Disconnect pitman arm at center link, using Puller, J-8990, and lower steering linkage.
8. Remove transmission lower cover.
9. Remove nuts and cap screws that hold oil pan to cylinder block and remove oil pan.
10. Remove side gaskets and rubber front and rear seals from oil pan, and discard.

b. Installation

1. Cement new gasket to both sides of oil pan, lining up holes in gaskets with holes in oil pan flange.
2. Thoroughly clean front and rear seal surfaces of oil pan, and install new oil pan front and rear seals by pulling locating tangs on seals through locating holes in seal flange. Make sure seals are firmly positioned on flange surfaces with ends of each seal properly located in cut-out notches in side gaskets.
3. Seal all four corner notch openings with a coating of cement.
4. Clean out notches in block where ends of oil pan rear seal fit. Fill this rectangular cavity with Transmission Cooler Hose Cement.

NOTE: This cement will be easier to apply if the tube has been stored in a cool location to prevent the contents from becoming too thin.

5. Position oil pan on bottom surface of cylinder block, and install cap screws and nuts tightening to 10 foot-pounds.
6. On 693 cars install engine as described in Note 110b.
7. Install transmission lower cover and secure with four cap screws. Tighten screws to 20 foot-pounds.

8. Connect pitman arm to center link.
9. Secure idler arm support mount to frame with two attaching screws and lockwashers. Tighten screws to 35 foot-pounds.
10. Secure starter motor to cylinder block as described in Note 26b.
11. Install exhaust "Y" pipe as described in Section 8, Note 6b.
12. Add four quarts engine oil to crankcase. Use five quarts on Eldorado. Check oil dipstick for proper oil level.
13. Connect negative battery cable.
14. Run engine and check for leaks at all connections.

123. Oil Pump

a. Removal

1. Raise car.
2. Remove oil filter.
3. Remove five screws securing oil pump to engine. The screw nearest the pressure regulator should be removed last, allowing the pump to come down with screw.
4. Remove pump drive shaft.

b. Installation

1. Pack pump with petrolatum.
2. Position new gasket on pump housing.
3. Engage pump drive shaft with distributor drive and guide into oil pump drive gear.
4. Install pump to engine by allowing it to ride up as screw nearest pressure regulator is turned in.
5. Install remaining four screws. Tighten all five screws to 15 foot-pounds.
6. Install oil filter.
7. Run engine and check for leaks in pump area.
8. Lower car.

124. Oil Pump Disassembly, Inspection and Assembly

a. Disassembly

1. Slide drive shaft, drive gear and driven gear out of pump housing.
2. Using a 5/16 inch hex head wrench, remove plug from pump housing assembly, and remove oil pressure regulator valve and spring from bore in housing assembly.

b. Inspection

1. Inspect oil pressure regulator valve for nicks and burrs that might cause a leak or binding condition in bore of pump housing.
2. Check free length of regulator valve spring. It should be approximately 2.57 inches to 2.69 inches in length. A force of 6-1/4 to 6-3/4 pounds should be required to compress the spring to 1-7/16 inches.
3. Inspect drive gear and driven gear for nicks and burrs.
4. Inspect pump housing for wear and score marks.
5. Check pump mating surfaces on engine block for wear and score marks.

c. Assembly

1. Install oil pressure regulator valve and spring in bore of pump housing assembly.
2. Using a 5/16 inch hex head wrench, install plug in housing assembly and tighten plug to 11 foot-pounds.
3. Install pump drive gear over lower shaft in pump housing.
4. Slide driven gear over remaining shaft in pump housing, meshing driven gear with drive gear.

NOTE: The hex markings on both gears should be installed upwards toward the crankcase.

125. Rear Main Bearing Oil Seal Replacement

Rear main bearing seal installation can be properly accomplished by using a simple, easily made tool, Fig. 6-118. Make the tool out of a metal banding strap or shim stock. The tool will act as a "shoehorn" to protect the backbone or outer diameter of the seal from scraping against the sharp edges of the cylinder block. Replacement procedure is as follows:

1. Raise car.
2. Disconnect spark plug wires and remove spark plugs.
3. Remove oil pan as described in Note 122a.
4. Loosen two screws that hold rear main bearing cap to cylinder block and remove cap with screws.
5. Remove lower seal half from bearing cap and discard.
6. Rotate upper seal half by pushing on one end with sharp object, and remove upper seal half from cylinder block.

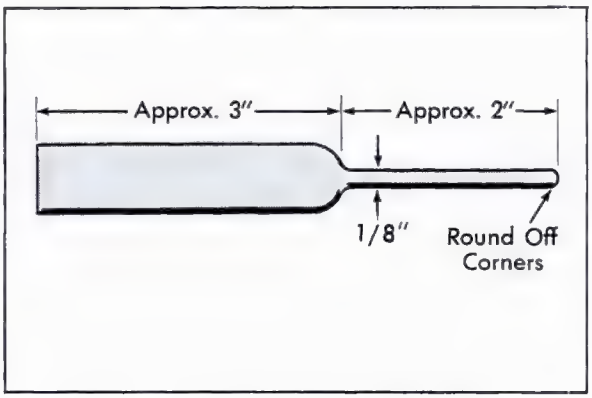


Fig. 6-118 Main Bearing Oil Seal Tool

Fig. 6-119 Installing Rear Main Oil Seal

7. Inspect grooves in bearing cap and cylinder block to be sure they are clean, dry and free from burrs.

NOTE: The two seal halves are identical and can be used in either the lower or upper location. Both seal halves are pre-lubricated with a film of wax for break-in. Do not remove or damage this film.

8. To install lower half of seal into the bearing cap, slide either end of seal into position at one end of bearing cap and place tool in groove at other end of bearing, Fig. 6-119. Make sure the seal is positioned in the groove and the lip of the seal is facing forward (car position).

9. Hold thumb or finger over end of seal that is flush with split line to prevent it from slipping upward, and push seal into seated position by applying pressure to the other end.

10. Make sure seal is pressed down firmly and is flush on each side to avoid possibility of a leak at the seal split line. Avoid pressing on lip as damage to sealing edge could result.

11. To install upper half of seal in cylinder block (with crankshaft in car), position "shoehorn" in groove of block. Start seal into groove in block with lip facing forward and rotate seal into position, using care not to distort seal, Fig. 6-119.

12. Do not press on lip or sealing edge of seal may be damaged. Also, both ends of seal should be flush at the seal split line to avoid leaks.

13. If necessary, Lubriplate, or its equivalent, may be used to facilitate installation of both lower and upper half of seal. Do not use silicone or an oil leak may result.

14. Install bearing cap and secure with attaching screws. Tighten screws to 95 foot-pounds.

15. Rotate crankshaft 360° to make sure crankshaft is not binding.

16. Install oil pan as described in Note 122b.

17. Install spark plugs and tighten to 25 foot-pounds. Connect spark plug wires.

18. Run engine and check for oil leaks.

19. Lower car.

126. Harmonic Balancer

a. Removal

1. Disconnect negative battery cable.

2. Remove carburetor air cleaner.

3. Drain coolant from radiator and cylinder block.

4. Loosen hose clamp at radiator inlet pipe, and remove one screw securing hose retainer at radiator cradle. Position upper radiator hose out of way.

5. Remove fan blade assembly as described in Note 6a or 7a.

6. Remove generator belt, A.I.R. pump belt, and power steering pump belts.

7. Remove four cap screws that hold crankshaft pulley to harmonic balancer. Place scribe marks on pulley and balancer for proper installation.

8. Remove plug from end of crankshaft.

9. Install Harmonic Balancer Puller Pilot, J-21052-4, in bore in end of crankshaft, Fig. 6-120.

10. Install Holding Base, J-21052-1, on front of pulley, lining up holes on base with screw holes in harmonic balancer, and install four holding screws with washers finger tight, Fig. 6-121. Do not use a wrench to tighten screws.

11. Thread Puller Screw, J-21052-2, into base until screw contacts pilot.

12. Using a wrench, remove harmonic balancer assembly from crankshaft, Fig. 6-121.

NOTE: Use of shop air pressure to hole one piston within its compression stroke will make is possible to remove harmonic balancer without turning the crankshaft. Remove a spark plug, install Adapter J-22794 in spark plug port, and apply air pressure to hold piston within its compression stroke.

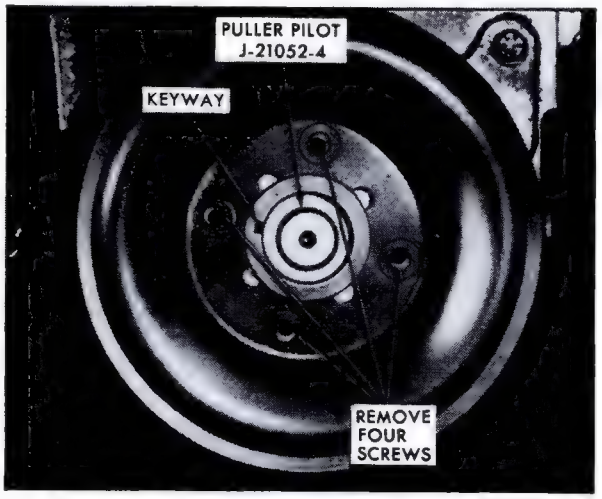


Fig. 6-120 Installing Balancer Pilot

13. Remove pilot from end of crankshaft and remove Harmonic Balancer Puller from harmonic balancer.

b. Installation

1. Lubricate bore of balancer with E.P. lubricant to prevent seizure to crankshaft.
2. Position harmonic balancer assembly on crankshaft, lining up key shot in harmonic balancer with key on crankshaft.
3. Place Holding Base, J-21052-1, against front face of pulley and thread Installer Screw, J-21052-5, into end of crankshaft. Position thrust bearing with inner race forward, washer next, and Installer Nut, J-21052-6, last, Fig. 6-122.
4. Using a wrench, install harmonic balancer on crankshaft.

NOTE: Use of shop air pressure, as explained in removal procedure, will make it possible to install harmonic balancer assembly without turning crankshaft.

5. When harmonic balancer assembly is positioned on crankshaft, remove Harmonic Balancer Remover and Installer. Do not try to install harmonic balancer all the way with this tool, or tool will be damaged. Thread a 1962 harmonic balancer-to-crankshaft screw and washer in end of crankshaft. Tighten screw to 125 foot-pounds.
6. Install four pulley to harmonic balancer screws that were previously removed and tighten all four screws to 15 foot-pounds.
7. Remove screw and washer from end of crankshaft, and install plug in end of crankshaft.
8. Exhaust air pressure from cylinder, remove Adapter, J-22794, and install spark plug.
9. Install pulley and fan blade assembly on water pump as described in Note 6b or 7b.
10. Install power steering pump belt, A.I.R. pump belt and generator drive belts on pulleys.
11. Adjust all belts as described in Note 11.

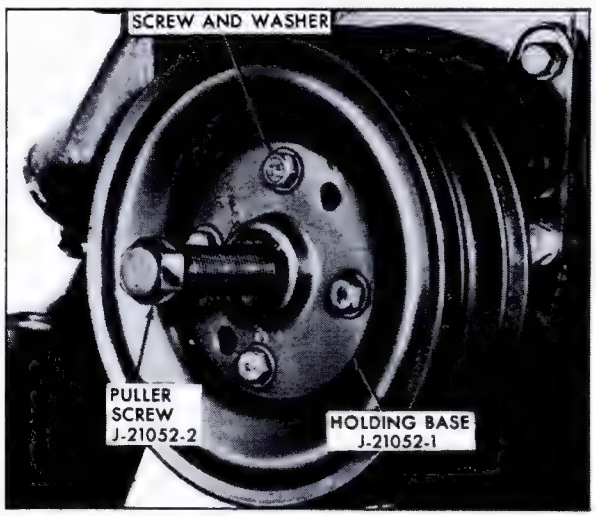


Fig. 6-121 Removing Balancer

12. Connect upper radiator hose at radiator inlet pipe and secure with hose clamp. Secure hose retainer to radiator cradle with one screw.
13. Lower car.
14. Refill cooling system with coolant.
15. Reconnect negative battery cable.
16. Install carburetor air cleaner.
17. Run engine to check for coolant and oil leaks.

127. Engine Front Cover

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described in 110a.
2. Remove harmonic balancer as described in Note 126a.
3. Drain oil from oil pan.
4. Remove oil pan as described in Note 122a.
5. Loosen hose clamp at water pump inlet and remove lower radiator hose from water pump.
6. Remove 12 screws that hold front cover to cylinder block and remove cover with water pump attached. Discard gasket.

b. Installation

1. Position new front cover gasket over locating dowels on cylinder block.

NOTE: Apply a small amount of gasket cement to hold gasket in place.

2. Install front cover, with water pump attached, over end of crankshaft, lining up dowel holes in cover with locating dowels on cylinder block. Secure with attaching screws. Refer to Fig. 6-123 for proper screw location and torque specifications.
3. Install harmonic balancer as described in Note 126b.
4. Install oil pan sa described in Note 122b.
5. If working on Eldorado, install engine in vehicle chassis as described in Note 110b.
6. Install lower radiator hose to water pump inlet and secure with hose clamp.

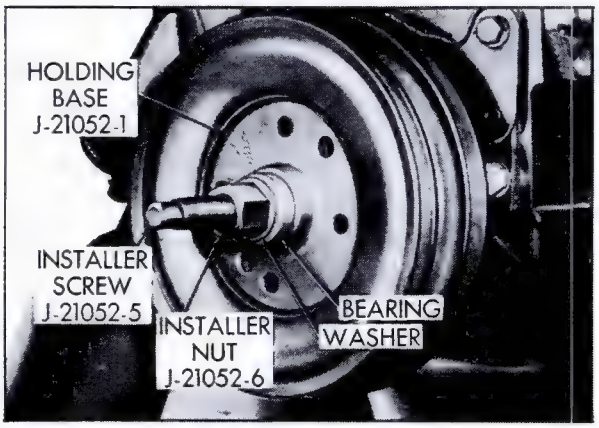


Fig. 6-122 Installing Balancer

7. Refill cooling system and crankcase as described in Notes 1 and Section 0, Note 2c, respectively.
8. Run engine and check for leaks.

128. Front Cover Oil Seal Replacement (Fig. 6-124)

a. Removal

1. Remove harmonic balancer as described in Note 126a.
2. With thin-bladed screwdriver or similar tool, pry out front cover oil seal. Discard seal.

b. Installation

1. Lubricate new oil seal by filling the cavity between the lips with wheel bearing grease. Position seal on end of crankshaft with garter spring side toward engine.
2. Using Seal Installer, J-22770, and hammer, drive seal into front cover until it bottoms against front cover, Fig. 6-124.
3. Install harmonic balancer as described in Note 126b.

129. Timing Chain and Sprockets

a. Removal

1. Remove engine front cover as described in Note 127a.

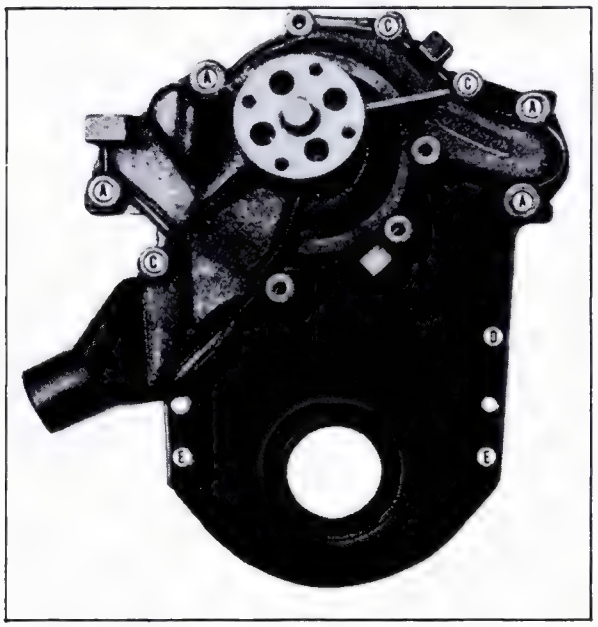


Fig. 6-123 Engine Front Cover Attaching Screws

Key	(No.)	Size	Torque
A	(4)	3/8-16 x 1-3/8	25 Foot-Pounds
C	(3)	5/16-18 x 1-1/4	15 Foot-Pounds
D	(1)	5/16-18 x 5/8	15 Foot-Pounds
E	(2)	3/8-16 x 5/8	25 Foot-Pounds

2. Remove ignition distributor as described in Note 48a.
3. Remove oil slinger from crankshaft.
4. Remove fuel pump as described in Note 102a.
5. Remove screw securing fuel pump eccentric to camshaft and remove eccentric.
6. Remove two screws securing camshaft sprocket to camshaft.
7. Remove camshaft sprocket with chain attached.
8. Remove crankshaft sprocket.
9. Remove woodruff key from crankshaft keyway.

b. Installation

1. Using a soft faced hammer, seat woodruff key in crankshaft keyway.
2. Install crankshaft sprocket on crankshaft, with timing mark toward front and sprocket keyway lined up with key in crankshaft.
3. Install camshaft sprocket in timing chain with timing mark toward front.
4. Place chain over crankshaft sprocket and line up timing marks on both sprockets, Fig. 6-125.

NOTE: Engine is being timed so that cylinder #4 is in the firing position.

5. Hold camshaft sprocket in position against end of camshaft and press sprocket on camshaft by hand, being sure index hole in camshaft is lined up with index hole in sprocket.
6. Install two screws and lockwashers securing camshaft sprocket to camshaft. Tighten screws to 18 foot-pounds.
7. Install fuel pump eccentric on camshaft and secure with screw. Tighten screw to 35 foot-pounds.

Fig. 6-124 Installing Front Cover Oil Seal

8. Install fuel pump as described in Note 102b.
9. Install oil slinger on crankshaft with smaller end of slinger against crankshaft sprocket.
10. Install engine front cover as described in Note 127b.
11. Install ignition distributor as described in Note 48b.

NOTE: Engine timing has been set so that cylinder #4 is in the firing position. When installing the distributor, either set the rotor so that cylinder #4 is firing or crank the engine 180° and set ignition timing on cylinder #1.

130. Camshaft—Removal and Installation

a. Removal

1. If working on Eldorado, remove engine as described in Note 110a.
2. Remove timing chain and sprockets as described in Note 129a.
3. Remove valve lifters as described in Note 116a.
4. Remove radiator as described in Section 13, Note 1a.
5. Slide camshaft forward carefully until it is out of engine.

CAUTION: Extreme care must be exercised to keep cam lobes from scratching camshaft bearings.

b. Inspection

The camshaft on 1969 engines is made of alloy cast iron. It must be handled with particular care to avoid damage.

Whenever camshaft has been removed from engine, or faulty camshaft action is suspected in diagnosing engine conditions, the camshaft lobes should be checked for wear. This may be done visually, with camshaft installed in engine, by removing hydraulic lifters and noting condition of camshaft lobes. Excessive wear, scoring, or flaking of the lifter will usually denote camshaft wear. If excessive camshaft wear, scoring or flaking is apparent, camshaft should be replaced.

The 1969 camshaft intake lobes have a lift of .440 inch. Exhaust lobes have a lift of .454 inch. The intake exhaust lobes are arranged from front to rear in the following order: No 1 exhaust, No. 2 intake, No. 1 intake, No. 2 exhaust, No. 3 exhaust, No. 4 intake, No. 3 intake, No. 4 exhaust, No. 5 exhaust, No. 6 intake, No. 5 intake, No. 6 exhaust, No. 7 exhaust, No. 8 intake, No. 7 intake, and No. 8 exhaust.

Bearing journals should not be scored or burned. Cam lobes should be smooth and free of burrs and grooves. If abnormal wear or grooves are noted, camshaft should be replaced. Camshaft bearings should be visually inspected, in their bores, for excessive wear.

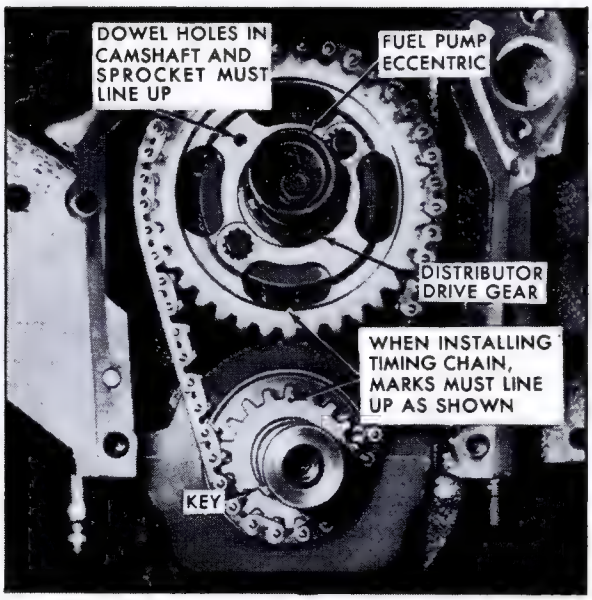


Fig. 6-125 Timing Sprockets

c. Installation

1. Apply a thin coat of rear axle lubricant to all camshaft lobes and bearing journals.
2. Guide camshaft carefully into cylinder block.

CAUTION: Extreme care must be exercised to avoid nicking or scratching camshaft bearings.

3. Install valve lifters as described in Note 116b.
4. Install timing chain and sprockets as described in Note 129b.
5. Install radiator as described in Section 13, Note 1b.
6. Install engine in car as described in Note 110b, if working on Eldorado.

131. Camshaft Bearing Replacement

Babbit type camshaft bearings are used on all 1969 engines. Whenever camshaft has been removed from engine for inspection, these bearings should be visually inspected in their bores for excessive wear. If excessive wear is evident, all five bearings should be replaced. A precision pre-machined camshaft bearing, interchangeable bore to bore, is available for field replacement.

a. Removal

1. Remove camshaft as described in Note 130a.
2. Thread Arbor, J-21054-2 on end of Drive Shaft, J-21054-1, and position shoulder on arbor against front face of No. 1 bearing, Fig. 6-126.
3. Using a hammer, drive out No. 1 bearing through rear face of bearing bore. Remove bearing from arbor and discard.
4. Remove remaining four bearings in same manner. When removing No. 5 bearing, drive out

rear cup plug, located behind No. 5 bearing, along with bearing.

b. Installation

1. Install new cup plug in rear of No. 5 bearing bore and seal plug with a permanent type sealer.
2. Locate center oil passage in each bearing bore and scribe a reference mark on front face of each bore, Fig. 6-127.
3. Slide Drive Shaft, J-21054-1, with Arbor, J-21054-2, through No. 1, 2, 3 and 4 bearing bores until arbor is positioned between No. 4 and No. 5 bores.
4. Place new bearing on Arbor and position in No. 5 bearing bore, lining up oil hole in bearing with scribe mark on front face of bore, Fig. 6-128.
5. Using a hammer, install bearing in bore until oil hole in bearing is lined up with oil passage in bore.
6. Install No. 4, 3, 2 and 1 bearings in the same manner.
7. Install camshaft as described in Note 130b.

132. Crankshaft Removal and Installation

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 110a. Proceed to Step 3.
2. Raise car.
3. Remove oil pan as described in Note 122a.
4. Remove timing chain and sprockets as described in Note 129a.
5. Remove screws and nut securing oil pick-up tube and strainer assembly to cylinder block and remove intake screen assembly. Discard O-ring.
6. On all cars except 693 remove transmission as described in Section 7, Note 13a.
7. Remove six screws that hold flexplate to crankshaft and remove flexplate.
8. Remove spark plugs.
9. Disconnect connecting rods and, using Connecting Rod Guide Set, J-3224, to protect journals, push pistons up into cylinders so that crankshaft can be removed without interference.
10. Remove front and rear main bearing caps.
11. Support crankshaft at front and rear and remove three intermediate bearing caps.
12. Remove crankshaft from engine.

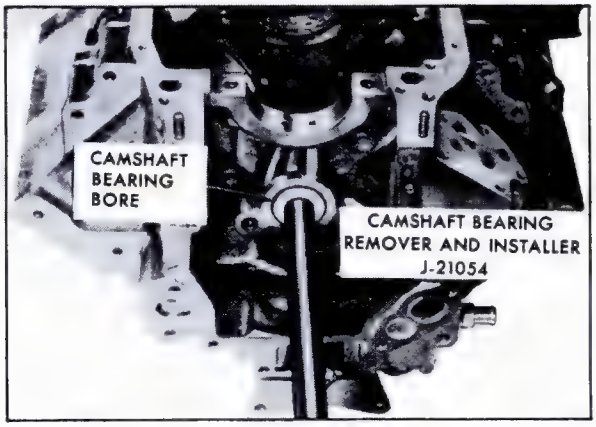


Fig. 6-126 Removing Camshaft Bearings

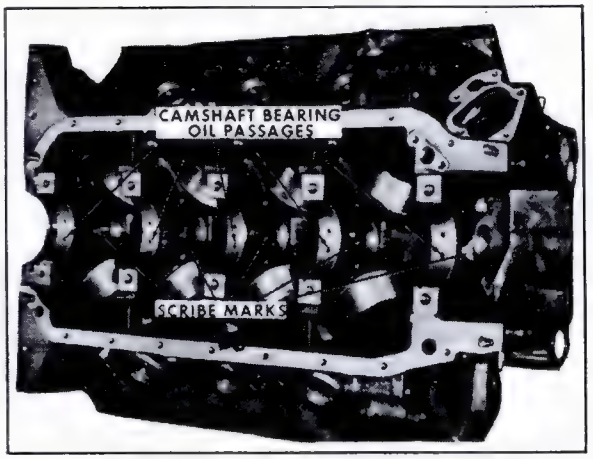


Fig. 6-127 Camshaft Bearing Oil Passages

b. Installation

1. Place crankshaft in position and support in place while installing main bearing caps as described in Note 139. Use a new rear main bearing oil seal as described in Note 125.

NOTE: Each bearing cap has a number (1, 2, 3, or 4) stamped on the bottom starting from the front of the engine as shown in Fig. 6-129. Do not mismatch these caps or turn them around because they are individually matched as the cylinder block is machined.

2. Lubricate crankpins with engine oil and pull connecting rods down toward crankshaft. Use Connecting Rod Guide Set, J-3224, to protect journals.
3. Install connecting rods on crankshaft as described in Note 133b.

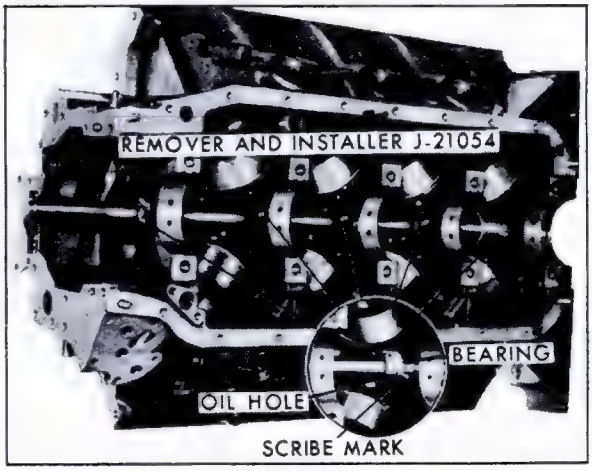


Fig. 6-128 Installing Camshaft Bearings

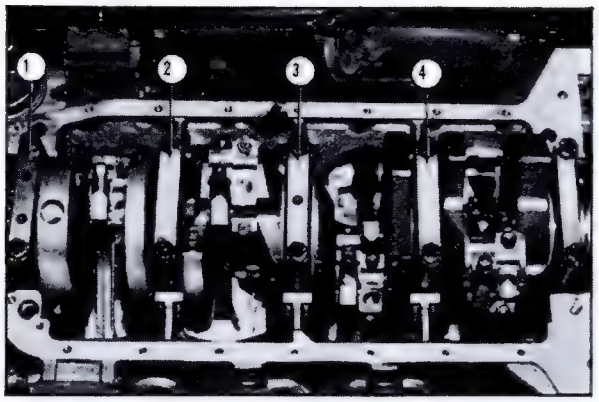


Fig. 6-129 Main Bearing Caps

4. Install oil pick-up tube and strainer assembly with new O-ring on cylinder block and secure with two screws and nut. Tighten to 18 foot-pounds.

5. Install flexplate and secure with six screws. Tighten screws to 75 foot-pounds.

6. On all cars except 693, install transmission as described in Section 7, Note 13b.

7. Install spark plugs. Tighten to 25 foot-pounds.

8. Install timing chain and sprockets as described in Note 129b.

9. Install oil pan as described in Note 122b.

10. Lower car.

11. If working on Eldorado, install engine in vehicle chassis as described in Note 110b.

133. Connecting Rod and Piston—Removal and Installation

a. Removal

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 110a.

2. Remove cylinder heads as described in Note 119a.

3. Clean carbon from top of cylinder bore. Ream upper ridges if necessary to prevent breakage or distortion of piston ring lands due to rings catching in the ridge. Pack cylinder bore with cloth to catch shavings.

4. Remove oil pan as described in Note 122a.

5. Remove two cap screws that hold oil pick-up tube and strainer assembly to cylinder block. Discard O-ring.

6. Remove connecting rod cap by removing connecting rod nuts and sliding cap down off connecting rod bolts. Fig. 6-130.

7. Install Connecting Rod Guide Set, J-3224, on connecting rod bolts.

CAUTION: Be careful not to damage crankshaft or cylinder bore when removing piston and rod assembly.

8. Push connecting rod and piston assembly up until piston rings are out of bore, and remove

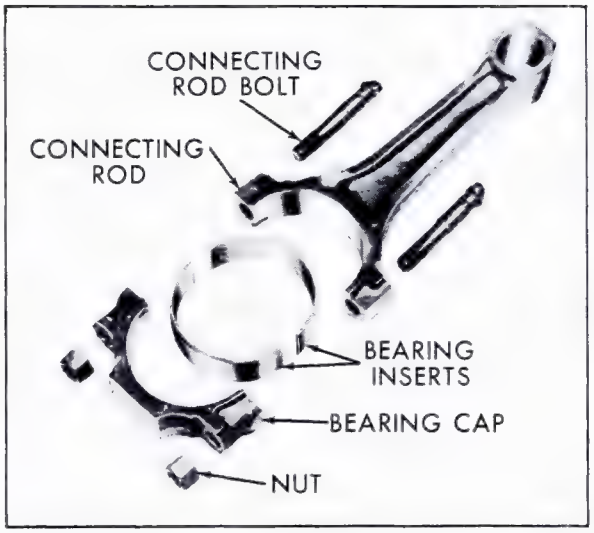


Fig. 6-130 Connecting Rod and Bearings

piston and connecting rod assembly from engine.

CAUTION: Be careful not to nick lower edge of bore when pushing rod up.

9. Remove remaining seven piston and connecting rod assemblies in same manner.

b. Installation

1. Removing connecting rod cap from connecting rod and install bearing inserts in both cap and rod, being careful to locate bearing tangs in locating notches.

2. Install Connecting Rod Guide Set, J-3224, on rod bolts to protect crankpin journals.

3. Using Piston Ring Compressor, J-22748, position capless rod and piston in cylinder bore with arrow in trough pointing toward front of engine (letter "R" on piston roward rear) Fig. 6-131.

4. Using wood hammer handle, push piston and connecting rod down into position on crankpin and remove Connecting Rod Guide Set, J-3224.

CAUTION: Extreme care must be exercised when installing pistons and rods to be sure rod is lined up with crankshaft journals and does not stick or bind on counterweights.

5. Install connecting rod cap with bearing in place, over connecting rod bolts, making sure numbered side of cap is on same side as numbered side of rod.

6. Install remaining seven piston and connecting rod assemblies in the same manner.

NOTE: Recheck to see that numbered sides of connecting rods on Nos. 1, 3, 5, and 7 rods are on right side of engine and Nos. 2, 4, 6 and 8 are on left side of engine, and that rods are on proper crankpin.

7. Install rod cap nuts and tighten to 40 foot-pounds.

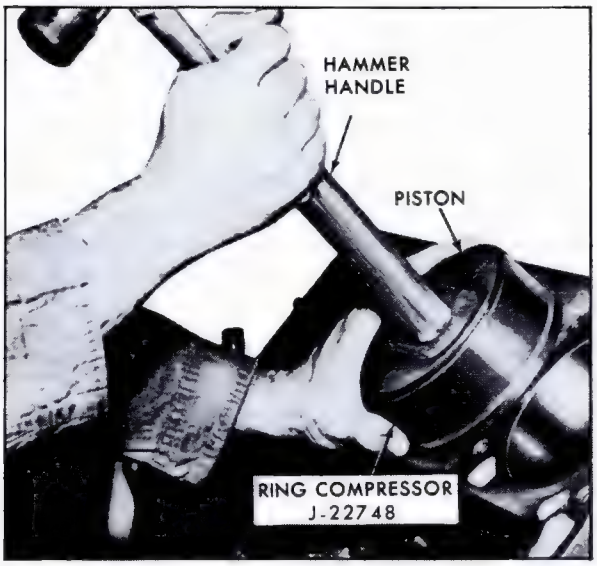


Fig. 6-131 Installing Piston in Cylinder Block

8. Check connecting rod end play on crankpin by tapping the two rods apart at crankpin and checking with feeler gage. An .008 inch feeler gage should always enter space between rod passes at crankpin: a .016 inch feeler gage should never enter.

9. Install oil pick-up tube and strainer assembly on cylinder block, using new O-ring and secure with attaching screws. Tighten screws and nut to 18 foot-pounds.

10. Install oil pan as described in Note 122b.

11. Install cylinder heads as described in Note 119b.

12. If working on Eldorado, install engine in vehicle chassis as described in Note 110b.

134. Connecting Rod Bearing Clearance Checking and Replacement

Worn bearings can be replaced without removing the rod and piston assembly by removing the cap and replacing the upper and lower halves. The clearance getween the connecting rod bearing and the crankshaft can be measured by the use of a "Plastigauge", as follows:

1. Remove bearing cap and wipe oil from crankshaft journal and bearing insert.

2. With crankpin at approximate bottom dead center, place a piece of "Plastigauge" in center of cap.

NOTE: When using "Plastigauge", plastic material and part being measured must both be at room temperature. If parts are excessively warm, and incorrect reading may result. Fresh "Plastigauge" is recommended for greatest accuracy.

3. Reinstall bearing cap. Tighten screws to 40 foot-pounds.

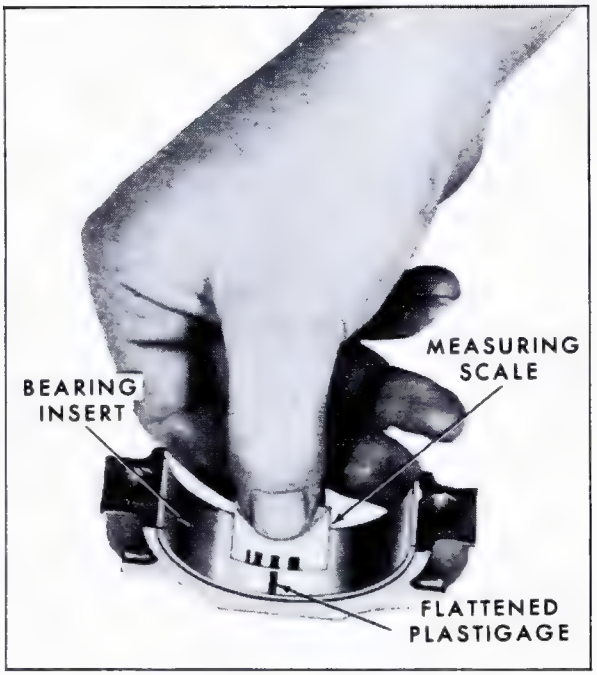


Fig. 6-132 Checking Bearing Clearance

NOTE: It is extremely important to position tangs on bearings in notches in rod and cap.

4. Remove bearing cap and determine clearance by comparing width of flattened "Plastigauge", at its widest point, with graduations on "Plastigauge" container. Number within matching graduation on envelope indicates clearance in thousandths of an inch, Fig. 6-132.

If clearance is greater than .0035 inch, replace bearing. If new bearings do not reduce clearance to less than .0035 inch, crankshaft must be replaced to obtain specified limits. If both new bearings and new crankshaft are installed, clearance should be from .0005 inch to .0028 inch.

135. Piston Ring Replacement

Each piston has two compression rings and a side-seal type oil ring that incorporates a steel expander and two identical chrome plated steel rails. The top compression ring is molybdenum filled cast iron. The second compression ring is coated cast iron.

When replacing piston rings, install only re-ring sets that have molybdenum filled upper compression ring, and multi-piece oil rings.

The compression rings are chamfered on the lower inner face. There is a locating "dimple" on both rings near the end for easy identification on the top side. Install with top side, "dimple", facing up.

1. Place ring in area of cylinder where piston ring will travel. Be sure ring is square with cylinder bore by positioning ring with piston head.

2. Gap between compression ring ends should be .013 inch to .025 inch.

3. Gap between oil ring ends should be .015 inch to .055 inch.

4. With compression ring on piston, clearance between top surface of piston ring and ring land should be no greater than .005 inch. If clearance is greater, replace the ring. If the new ring does not reduce the clearance to .005 inch or less, new pistons should also be installed.

Clearance on new rings and new pistons should be .0017 inch to .0040 inch. This can be checked with a .0015 inch and a .005 inch feeler gage on a "go-no-go" basis. The .0015 inch feeler gage should always enter; the .005 inch feeler gage should never enter. When installing rings on piston, gaps in piston rings should be staggered by approximately 120°.

136. Piston Pin Removal and Installation

a. Removal

1. Place Piston Pin Support, J-8390-8, on arbor press.

2. Insert Piston Pin Pilot, J-8390-9, in piston pin on side opposite letter "R" on piston.

3. Position piston and connecting rod assembly on support with side of piston marked with the letter "R" upward, Fig. 6-133.

4. Insert pilot end of Piston Pin Remover and Installer, J-8390-6, into piston pin and press pin out of piston and rod assembly.

5. Remove assembly from press and remove piston from support.

NOTE: Keep piston pins in order so that they can be installed in the piston from which they were removed.

b. Installation

1. Lubricate piston pin and pin holes in piston with engine oil to facilitate installation.

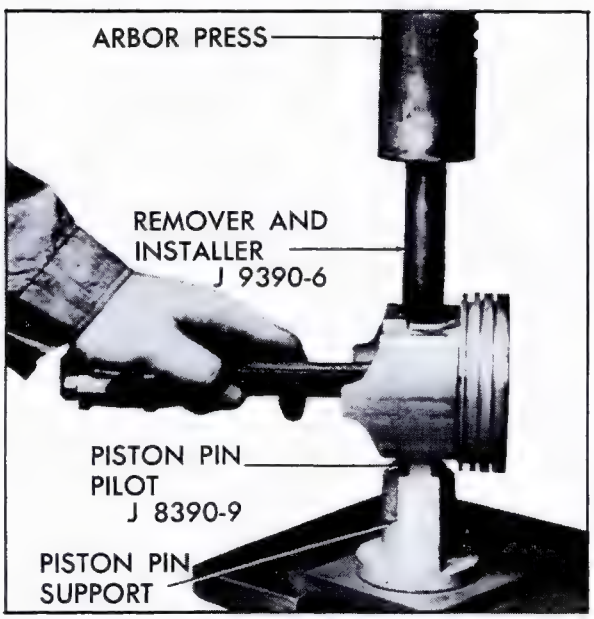


Fig. 6-133 Piston Pin Removal

2. Place Piston Pin Support, J-8390-8, on arbor press with Spring, J-8390-4, and Spacer, J-8390-2, with open end over spring in position in Support, Fig. 6-134.

3. Position connecting rod in its respective piston so that, when assembly is installed in engine, side of piston stamped with the letter "R" is toward rear of the engine and number on lower end of rod is down (Numbers 1, 3, 5, and 7 are in the right bank and 2, 4, 6, and 8 are in the left bank.)

4. Position piston with connecting rod on Piston Pin Support, and insert piston pin into position as shown in Fig. 6-134.

5. Place Piston Pin Remover and Installer, J-8390-6, on piston pin and press pin until it bottoms on spacer in support. Remove piston and connecting rod from support. Center pin in piston, this will properly locate the connecting rod on the piston pin and piston.

NOTE: Piston pins are a selective fit to the piston and are not available separately. Piston pins will not normally wear enough to cause a knock or tapping; however in cases where wear is abnormal, a new piston and pin assembly should be installed.

137. Piston Clearance

When measuring piston diameter, the micrometer should be placed 3/16 inch below the cross slot or 1/4 inch below the oil ring groove, Fig. 6-135. Cylinders must be measured by placing the micrometer 1-1/8 inches from the top, and perpendicular to the centerline of the face.

An identification letter is stamped on the cylinder head face of the cylinder block. The letter is located directly below the cylinder bore. This letter denotes the cylinder-piston size as shown in the following table:

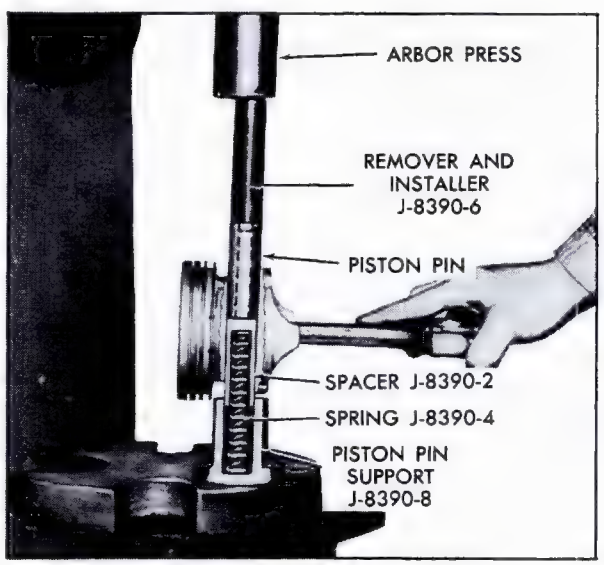


Fig. 6-134 Piston Pin Installation

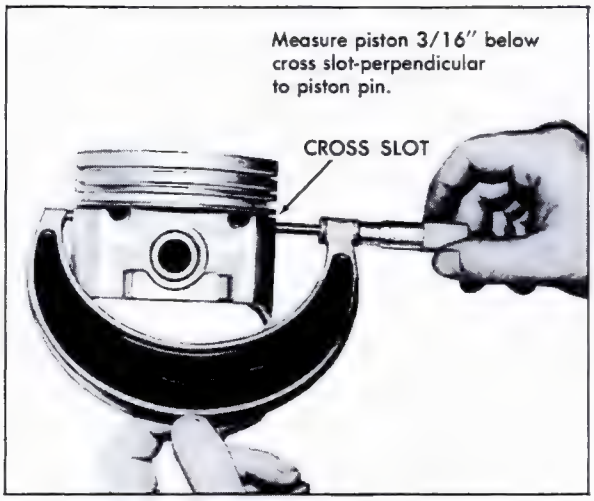


Fig. 6-135 Measuring Piston Diameter

Letter	Cylinder Size (Diameter in Inches)	Piston Size (Diameter in Inches)
A	4.3000 - 4.3002	4.2992 - 4.2994
B	4.3002 - 4.3004	4.2994 - 4.2996
C	4.3004 - 4.3006	4.2996 - 4.2998
D	4.3006 - 4.3008	4.2998 - 4.3000
E	4.3008 - 4.3010	4.3000 - 4.3002
H	4.3010 - 4.3012	4.3002 - 4.3004
J	4.3012 - 4.3014	4.3004 - 4.3006
K	4.3014 - 4.3016	4.3006 - 4.3008
L	4.3016 - 4.3018	4.3008 - 4.3010
M	4.3018 - 4.3020	4.3010 - 4.3012

The table indicates ten piston sizes ranging in steps of .0002 inch from 4.2992 inches to 4.3012 inches. This makes it possible to maintain the .0006 to .0010 inch piston to cylinder wall clearance. The sizes shown apply at 70°F.

If double letters (such as "AA", "BB") appear on the cylinder head face of the block just above the cylinder bore, it indicates that this particular cylinder has been bored to .010 inch over the diameter indicated by a single letter in the chart. For example, a cylinder with the letters "CC" stamped on the block would have a diameter of 4.3104 inches to 4.3106 inches; a matching piston for this size would have a diameter of 4.3096 inches to 4.3098.

Orders for service pistons after the end of the 1969 model year will be filled in sizes C, E, J or L and "HH, JJ or KK" through the servicing Parts Warehouses.

1969 engine cylinder bores must not be reconditioned to more than .0100 inch oversize as pistons are not available over this range.

While the 1969 model is in production, specific code size pistons "A" through "M" and "AA" through "MM" are available from the factory Parts Warehouse in Detroit on a special order basis.

NOTE: Before special ordering specific code size pistons, it is very important to check the sizes of the cylinder bores by actual measurement. Actual measurement at the time of replacement is the only certain way to avoid error in ordering.

An outside micrometer and an inside micrometer are required to determine piston clearance. The outside micrometer, used for measuring piston diameter, must be adjusted to turn freely so that it can be adjusted up to the piston with a very light turning effort on the screw. If it is adjusted to get a frictional feel over the piston, it will show several tenths of a thousandth smaller than its actual size. With practice, fractional thousandths can be checked accurately.

The inside micrometer for measuring the cylinders may be used with or without an extension handle. It should be adjusted so the screw turns sufficiently tight to retain its setting while checking the cylinder at the different points to be measured.

The direct readings shown on the inside micrometer should not be taken as the cylinder sizes. With one end of the micrometer contacting the cylinder wall and the other being oscillated, adjust the micrometer until it will just slip through the cylinder with a light drag. Remove the micrometer, and measure its length with the outside micrometer, obtaining the same feel as when measuring the piston.

By this method, even if the two micrometers do not agree in readings, no error will result in arriving at the actual clearance of the piston in the cylinder.

138. Connecting Rod Alignment

Connecting rods are carefully aligned at the factory and it is not necessary to check their alignment in the field. Only in cases of damage will they become misaligned. If this condition does exist, the piston, pin and rod assembly should be replaced. Do not attempt to straighten connecting rods.

139. Main Bearing Clearance Checking and Replacement

Shell type main bearings of steel-backed aluminum and steel-backed babbitt are used in all 1969 engines. Proper location for these bearings is shown in Fig. 6-136. No 1 upper and lower bearing halves are interchangeable. No. 2 and 4 upper bearing halves are interchangeable. No. 2 and 4 lower bearing halves are interchangeable. No. 3 upper and lower bearing halves are not interchangeable. The crankshaft end thrust is taken by the center main bearing. The worn limit for crankshaft end play is .015 inch.

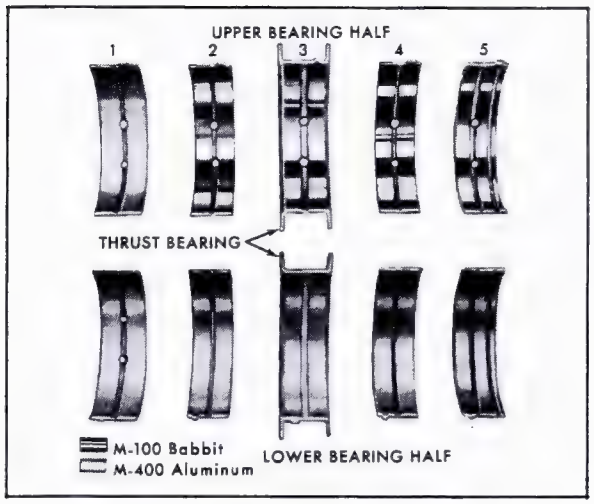


Fig. 6-136 Main Bearing Location

a. To Check a Main Bearing

1. Remove bearing cap to be checked.
2. Measure bearing wear using the "Plastigauge" Method as described in Note 134. Bearing cap must be tightened to 90 foot-pounds.

CAUTION: If bearings are being measured with engine in chassis, crankshaft must be supported in order to take up clearance between upper bearing shell and crankshaft. This can be done by removing bearing caps adjacent to bearing being checked, and placing a strip of .005 inch brass shim stock between lower bearing shell and crankshaft bearing journal. When reinstalling bearing caps, lightly tighten attaching screws to avoid damaging bearing caps.

3. If bearing clearance is greater than .0045 inch, replace bearing.
4. If new bearings do not reduce the clearance to less than .0045 inch, crankshaft should be replaced.

If both new bearings and new crankshaft are installed, clearance should be .0003 inch to .0026 inch for all bearings except front bearing. Clearance for front bearing should be .0001 inch to .0024 inch.

b. Main Bearing Replacement

1. If working on Eldorado, remove engine from vehicle chassis as described in Note 110a.
2. Remove engine oil pan as described in Note 122a.
3. Remove two cap screws and nut that hold oil intake screen assembly to cylinder block and remove screen assembly. Discard O-ring.
4. Remove spark plugs.
5. Remove two screws that hold bearing cap to cylinder block and remove cap. Remove worn shell from cap and discard.

NOTE: Each bearing cap has a number (1, 2, 3, or 4) stamped on the bottom starting from the front of the engine, as shown in Fig. 6-129. Do not mismatch these caps or turn them around because they are individually matched when the cylinder block is machined.

6. Install Upper Bearing Shell Remover, J-8080, into oil hole in crankshaft bearing journal, Fig. 6-137.
7. Slowly rotate crankshaft clockwise (viewed from front of engine) until tool contacts and forces out upper shell.
8. Install new upper shell in place as far as possible by hand, with locating tang in correct position. Remover Tool, J-8080, may also be used to aid in installing new upper shell. Install tool in crankshaft oil passage so that tool bears against notched end of bearing shell. Rotate crankshaft counterclockwise to position bearing, then remove tool, Fig. 6-137.
9. Install new lower shell in cap with locating tang in correct position.

NOTE: When replacing the rear main bearing, use a new oil seal as described in Note 125.

10. Install cap on cylinder block and secure with two attaching screws. Tighten screws to 90 foot-pounds.
11. Replace four remaining bearings in same manner.

NOTE: When replacing center bearing it is necessary to line up bearing thrust surfaces. To do this, install bearing cap screws finger tight. Then, using a plastic hammer, tap crankshaft fore and aft the limit of its travel several times. Do not use hammer on connecting rods, tap on counterweights only.

12. Install spark plugs and tighten to 25 foot-pounds. Connect spark plug wires at plugs.
13. Install oil intake screen assembly on cylinder block, using new O-ring, and secure with attaching screws and nut. Tighten to 18 foot-pounds.
14. Install oil pan as described in Note 122b.
15. If working on Eldorado, install engine in vehicle chassis as described in Note 110b.

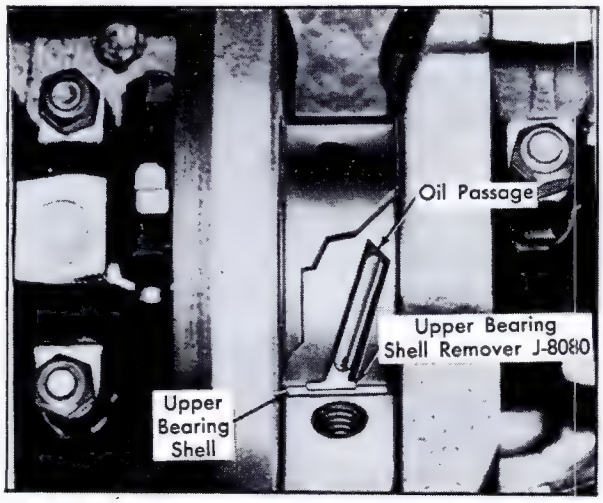


Fig. 6-137 Removing Upper Bearing Shell

140. Engine Support Mountings

a. (Except 693)

Three engine supports are used to mount the engines on all 1969 Cadillac cars. The front support mountings are located on each side of the cylinder block forward, and the rear support mounting is beneath the transmission extension housing.

The front support mountings are seated at an angle directly on the main front cross member of the frame and secured by studs. The rear support mounting at the transmission extension housing rests on a supporting cross member which is secured to the frame. All engines support mountings have rubber cushions to absorb vibrations and road shock.

It is important, when attaching the engine mountings to engine, transmission and frame, that the nuts and screws be tightened to the proper torque as follows:

Nut - Front Support Mount to Cylinder Block - 21 Foot-Pounds
Nut - Rear Engine Support Cross Member to Frame - 20 Foot-Pounds
Screw - Rear Support Mount to Rear Support Cross Member - 45 Foot-Pounds
Screw - Rear Support Mount to Transmission - 50 Foot-Pounds
Stud - Front Support Mount to Frame - 52 Foot-Pounds

Check at all three engine support mounting locations to be sure that no metal-to-metal contact can occur.

b. 693 (Fleetwood Eldorado)

Three engine supports are used to mount the engines on Eldorado 693. The front support mounting is located behind and below the engine front cover assembly, and the two rear mountings are on the right and left of the transmission.

The front mount is seated on the main front cross bar (Fig. 2-5) of the frame and is secured by studs. The rear support mountings are actually transmission support mountings. The engine is bolted with six bolts to the transmission.

These engine and transmission support mountings have rubber cushions to absorb vibration and road shock.

It is important, when attaching the engine mountings to engine, transmission and frame, that the proper torques be used.

Nut - Front mounting support bracket to crankcase bolt - 21 foot-pounds
Nut - Engine Front support cushion to frame stud - 35 foot-pounds

NOTE: Washer must be used with stud on right side.

Nut - Engine front support cushion to engine mounting bracket bolt - 57 foot-pounds
Bolt - Engine rear support bracket to transmission - 50 foot-pounds
Bolt - Engine rear support assembly to bracket - 46 foot-pounds
Bolt - Engine rear support assembly to frame - R.H. side - 52 foot-pounds
Nut - Engine rear support assembly to frame - L.H. side - 52 foot-pounds

Check at all three engine support mounting locations to be sure that no metal-to-metal contact can occur.

SPECIFICATIONS

Items	All Series Unless Otherwise Noted
Bore	4.30"
Stroke	4.06"
Piston Displacement	472 cu. in.
Compression Ratio	10.5 to 1
Horsepower --	
Rated (Taxable)	59.2
Developed at 4400 rpm	375
Torque, at 3000 rpm	525 ft. lbs.
Compression Pressure -	
At cranking speed (throttle open)	165-185 psi
At 1000 rpm	212-230 psi
Points of Suspension	3
VALVES, EXHAUST	
Clearance between stem and guides --	
New limits	.0010" - .0025"
Worn limits, not over	.005"
Clearance between lifter body and crankcase	.0005" - .0020"
Head diameter, overall	1.625"
Lift	.454"
Valve Face Angle	44°
Valve Seat Angle (in head)	45°
Seat width in head	1/16"
Seat eccentricity, not over (total indicator reading)	.004"
Stem diameter	.3415" - .3420"
Valve guide diameter (in head)	.343"
Rocker Arm Ratio	1.65-1
VALVES, INLET	
Clearance between stem and guide --	
New limits (in head)	.0005" - .0025"
Worn limits, not over	.005"
Clearance between lifter body and crankcase	.0005" - .0020"
Head diameter, overall	2.000"
Lift	.440"
Valve Face Angle	44°
Valve Seat Angle (in head)	45°
Seat Width in head	1/16"
Seat eccentricity, not over (total indicator reading)	.004"
Stem diameter	.3415" - .3425"
Valve guide diameter (in head)	.343"
Rocker Arm Ratio	1.65-1
VALVE SPRINGS	
Free length	2.250"
Pounds required to compress to 1.946" (Valve closed)	60 - 65
Pounds required to compress to 1.496" (Valve open)	155 - 165

Items	All Series Unless Otherwise Noted
VALVE TIMING (with ramp at .001" lift)	
Intake opens	18° B.T.D.C.
Intake closes	114° A.B.D.C.
Exhaust opens	70° B.B.D.C.
Exhaust closes	58° A.T.D.C.
CONNECTING RODS	
Bearing Material	M-400 Aluminum
Clearance between bearing and shaft --	
New limits	.0005" - .0028"
Worn limits, not over	.0035"
Diameter lower end, without bearing	
Length, center to center	6.75"
End play of rods on crank pin	.008" - .016"
PISTON RINGS	
Clearance between rings and sides of groove in piston --	
Compression rings	.0017" - .0040"
Oil rings	NONE - Side Sealing
Gap between ends	
Compression rings	.013" - .025"
Oil rings	.015" - .055"
Number of compression rings	2
Number of oil rings	1
Width of compression ring groove	.0802" - .0810"
Width of oil ring groove	.188" - .189"
Diameter at bottom of groove	
Oil ring	3.880" - 3.875"
Compression rings	3.844" - 3.849"
PISTON PINS	
Clearance between pin and piston --	
New limits	.00010" - .00020"
Pin length	3.030"
Pin diameter	.99935" - .99965"
PISTONS AND CYLINDERS	
Cylinder bore out-of-round (new or reground limit)	
Not over	.0005"
Piston Taper, not over	.0005" - .002"

SPECIFICATIONS (Continued)

Items	All Series Unless Otherwise Noted
Piston Material	Aluminum Alloy
Piston skirt top clearance	.0006" - .0010"
Piston skirt bottom clearance	-.0014" - +.0005"

Cylinder and piston sizes (as indicated by letters stamped on the cylinder head gasket surface). The letters are in groups of two for adjacent cylinders (such as "H" and "B") midway between the two cylinders. The letters denote the cylinder piston sizes as shown below).

Letter	Cylinder Size (Diameter in Inches)	Piston Size (Diameter in Inches)
A	4.3000 - 4.3002	4.2992 - 4.2994
B	4.3002 - 4.3004	4.2994 - 4.2996
C	4.3004 - 4.3006	4.2996 - 4.2998
D	4.3006 - 4.3008	4.2998 - 4.3000
E	4.3008 - 4.3010	4.3000 - 4.3002
H	4.3010 - 4.3012	4.3002 - 4.3004
J	4.3012 - 4.3014	4.3004 - 4.3006
K	4.3014 - 4.3016	4.3006 - 4.3008
L	4.3016 - 4.3018	4.3008 - 4.3010
M	4.3018 - 4.3020	4.3010 - 4.3012
AA	4.3100 - 4.3102	4.3092 - 4.3094
BB	4.3102 - 4.3104	4.3094 - 4.3096
CC	4.3104 - 4.3106	4.3096 - 4.3098
DD	4.3106 - 4.3108	4.3098 - 4.3100
EE	4.3108 - 4.3110	4.3100 - 4.3102
HH	4.3110 - 4.3112	4.3102 - 4.3104
JJ	4.3112 - 4.3114	4.3104 - 4.3106
KK	4.3114 - 4.3116	4.3106 - 4.3108
LL	4.3116 - 4.3118	4.3108 - 4.3110
MM	4.3118 - 4.3120	4.3110 - 4.3112

OIL PUMP	
Oil pump type	Spur Gear
Backlash between drive gears	.008" - .012"
Clearance between pump body and gears --	
New limits	.003" - .005"
Worn limits, not over	.005"
No. of teeth on each gear	9

Items	All Series Unless Otherwise Noted
CRANKSHAFT AND MAIN BEARINGS	
Clearance, main bearings --	
New limits	.0003" - .0026"
Worn limits, not over	.0045"
Main bearing caps --	
Bolt thread diameter	1/2"
Main bearing journal, diameter	3.250"
Main bearing journals, out-of-round not over	.00025"
Main bearing journal length --	
No. 1 and No. 5	1.1925"
No. 2 and No. 4	1.0595"
No. 3	1.0670"
Main bearings material	M-400 Aluminum and M-100 Babbitt
Crankpin diameter	2.500"
Crankpin out-of-round not over	.00025"
End play in crankshaft --	
New limits	.002" - .012"
Worn limits	.015"
OIL PRESSURE REGULATOR	
Clearance between valve plunger and housing --	
New limits	.0020" - .0035"
Worn limits, not over	.005"
Normal pressure at 30 mph	
Minimum	35 - 40 psi
Idle (average)	10 psi
Spring	
Free length	2.57" - 2.69"
Lbs. required to compress to 1-7/16"	6-1/4 - 6-3/4
Valve opens at	35 - 40 psi
CAMSHAFT	
Chain --	
Type	Silent Chain
Adjustment	None
Length	24"
Number of links	48
Pitch	.500"
Width	.750"
Bearing Clearance --	
New limits	.001" - .0022"
Worn limits, not over	.004"
Bearing out-of-round, not over	.002"
Number of bearings	5
Valve lift (intake)	.440"
Valve lift (exhaust)	.454"

TORQUE SPECIFICATIONS

Material No.	Application	Thread Size	Torque
260-M	A.I.R. Pump Pulley Screw	1/4-20	60 in. lbs
260-M	A.I.R. Manifold to Cylinder Head Bolt	3/8-16	30 ft. lbs.
280-M	Camshaft Sprocket to Camshaft Screws	5/16-18	18 ft. lbs.
1010	Carburetor to Intake Manifold Screw (Front)	5/16-18	10 ft. lbs.
280-M	Carburetor to Intake Manifold Screw (Rear)	5/16-18	14 ft. lbs.
1038	Connecting Rod Nut	3/8-24	40 ft. lbs.
300-M	Cylinder Head to Cylinder Block Screw (All-Special) Oiled	1/2-13	115 ft. lbs.
Special	Cylinder Head Temperature Switch	1/4" Pipe	6 ft. lbs.
286-M	Distributor Clamp Nut	5/16-24	15 ft. lbs.
286-M	Engine Front Support Mount to Cylinder Block Nut	3/8-24	21 ft. lbs.
286-M	Engine Front Support Mount Stud to Frame Nut	1/2-20	52 ft. lbs.
300-M	Engine Rear Support Mount to Rear Support Cross Member Bolt	3/8-16	45 ft. lbs.
280-M	Engine Rear Support Cross Member to Frame Bolt	5/16-18	20 ft. lbs.
280-M	Engine Rear Support Mount to Transmission Extension Housing Bolt	7/16-14	50 ft. lbs.
286-M	693 Engine Front Mounting Support Bracket to Crankcase Nut	3/8-24	21 ft. lbs.
286-M	693 Engine Front Support Cushion to Frame Nut	7/16-14	35 ft. lbs.
300-M	693 Engine Front Support Cushion to Engine Mounting Bracket Nut	7/16-20	57 ft. lbs.
280-M	693 Engine Rear Support Bracket to Transmission Bolt	7/16-14	50 ft. lbs.
280-M	693 Engine Rear Support Assembly to Bracket	7/16-14	46 ft. lbs.
280-M	693 Engine Rear Support Assembly to Frame (Bolt or Nut)	1/2-13	52 ft. lbs.
280-M	Exhaust Manifold to Cylinder Head Screw	3/8-16	35 ft. lbs.
280-M	Fan Blade Assembly Mounting Screw on Non-Air Conditioned Cars	5/16-24	12 ft. lbs.
286-M	Fan Blade to Clutch Assembly Mounting Nut - Air Conditioned Cars	5/16-18	15 ft. lbs.
300-M	Flex Plate to Converter Housing Screw	3/8-16	30 ft. lbs.
280-M	Flex Plate to Crankshaft Screw (All)	7/16-20	75 ft. lbs.
280-M	*Front Cover to Cylinder Block Screw	5/16-18	15 ft. lbs.
280-M	*Front Cover to Cylinder Block Screw	3/8-10	22 ft. lbs.
260-M	Fuel Pump to Engine Screw	5/16-18	14 ft. lbs.
280-M	Fuel Pump to Engine Nut	5/16-24	14 ft. lbs.
280-M	Fuel Pump Eccentric	3/8-16	35 ft. lbs.
260-M	Generator Adjusting Link to Generator Screw	5/16-18	10 ft. lbs.
260-M	Generator Support Bracket Screw	3/8-16	17 ft. lbs.
1112	Generator Support Bracket Nut	3/8-24	17 ft. lbs.
1010	Heater Hose Clamps	10-24	14 ft. lbs.
260-M	Ignition Coil Mounting Screw	5/16-18	15 ft. lbs.
280-M	Intake Manifold to Cylinder Head Screw	3/8-16	30 ft. lbs.
300-M	Main Bearing Cap to Cylinder Block Screw	1/2-13	90 ft. lbs.
260-M	Oil Pan Drain Plug	1/2-20	40 ft. lbs.
1010	Oil Pan to Cylinder Block Nut	5/16-24	10 ft. lbs.
1010	Oil Pan to Cylinder Block Screw	5/16-18	10 ft. lbs.
280-M	Oil Pump Assembly to Cylinder Block Screw	5/16-18	15 ft. lbs.
286-M	Oil Pick-up Tube and Strainer Assembly to Main Bearing Bolt	3/8-24	35 ft. lbs.
Special	Oil Pressure Switch	1/4" Pipe	20 ft. lbs.
280-M	Oil Pump Assembly to Engine Screw	5/16-18	15 ft. lbs.

TORQUE SPECIFICATIONS (CONT'D.)

Material No.	Application	Thread Size	Torque
280-M	Pulley to Harmonic Balancer Screw	5/16-18	17 ft. lbs.
280-M	**Rocker Arm Cover to Cylinder Head Screw	1/4-20	30 in. lbs.
300-M	Rocker Arm Support Bolt	7/16-14	60 ft. lbs.
Special	Starter Motor Brace Mounting Screw	5/16-18	12 ft. lbs.
Special	Starter Motor Brace Mounting Nut	1/4-20	70 in. lbs.
280-M	Starter Motor Mounting Screws	7/16-14	46 ft. lbs.
Special	Spark Plug	14mm	25 ft. lbs.
Special	Temperature Indicator Switch	1/2" Pipe	40 ft. lbs.
260-M	Thermostat Housing to Engine Screw	5/16-18	10 ft. lbs.
280-M	Transmission Housing to Cylinder Block	3/8-16	35 ft. lbs.
260-M	*Water Pump to Front Cover Screw	1/4-20	70 in. lbs.
280-M	*Water Pump to Cylinder Block Screw	5/16-18	15 ft. lbs.
280-M	*Water Pump to Cylinder Block Screw	3/8-16	22 ft. lbs.

*Refer to Fig. 6-123 for proper location.
**Retorque rocker arm covers after engine has been run.

NOTE: Refer to back of manual, Page 16-1, for bolt and nut markings and steel classifications.

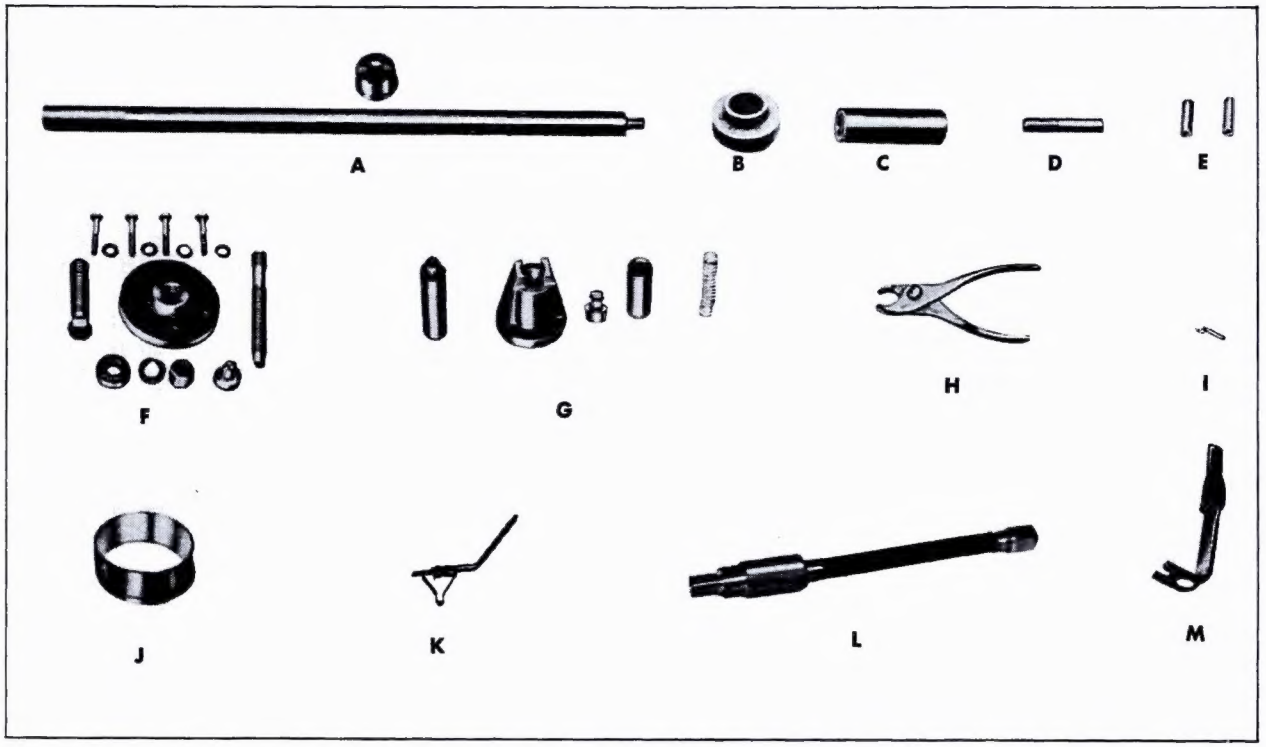


Fig. 6-138 Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-21054	Camshaft Bearing Remover and Installer Set	G	J-8390-04	Piston Pin Remover and Installer Set
B	J-22770	Front Cover Oil Seal Installer	H	J-3049	Valve Lifter Remover
C	J-4160	Hydraulic Valve Lifter Plunger Remover	I	J-8080	Main Bearing Upper Shell Remover
			J	J-22748	Piston Ring Compressor
D	J-2730	Valve Lifter Lock Ring Installer	K	J-3074	Valve Lifter Leak-Down Tester
E	J-3224	Connecting Rod Bolt Guide Set	L	J-22794	Adapter
F	J-21052	Harmonic Balancer Remover and Installer Set	M	J-22765-1	Valve Spring Compressor